Bioko Island Malaria Elimination Project (BIMEP)

Malaria Indicator Survey 2023

MCD Global Health, Equatorial Guinea

Ministerio de Sanidad y Bienestar Social

Ministerio de Minas Industria y Energía

The 2023 Bioko Island Malaria Indicator Survey (BIMIS) is implemented by MCD Global Health through the Bioko Island Malaria Elimination Project (BIMEP) and in close collaboration with the Equatorial Guinea National Malaria Control Program (NMCP). The BIMEP is funded by a public-private partnership between the government of Equatorial Guinea and Oil Companies (Marathon Oil Corporation, Noble Energy, Atlantic Methanol Company, Sonagas, and GEPetrol).

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ACRONYMS AND ABBREVIATIONS

AL	Artemether-Lumefantrine
AMPCO	Atlantic Methanol Production Company
ANC	Antenatal Care
ASAQ	Artesunate-Amodiaquine
BIMCP	Bioko Island Malaria Control Project
BIMEP	Bioko Island Malaria Elimination Project
BIMIS	Bioko Island Malaria Indicator Survey
CIMS	Campaign Information Management System
DBS	Dried Blood Spot
EA	Enumeration Area
EGMVI	Equatorial Guinea Malaria Vaccine Initiative
EIR	Entomological Inoculation Rate
GDP	Gross Domestic Product
GIS	Geographic Information System
HIS	Health Information System
HLC	Human Landing Catch
ICF	Inner City Fund
IEC	Information Education Communication
IHI	Ifakara Health Institute
IMR	Infant Mortality Rate
IPTp-SP	Intermittent Preventive Treatment In Pregnancy with Sulphadoxine-Pyrimethamine
IRB	Institutional Review Board
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
KAP	Knowledge, Attitude and Practices
LLIN	Long-Lasting Insecticidal Net
LRF	Local Residual Fraction
LSHTM	London School of Hygiene and Tropical Medicine
LSM	Larval Source Management
LSTM	Liverpool School of Tropical Medicine
LT	Light Trap
M&E	Monitoring And Evaluation
MAUP	Modifiable Areal Unit Problem
MCD	Medical Care Development Global Health
MDA	Mass Drug Administration
MDG	Millennium Development Goals
MoHSW	Ministry of Health And Social Welfare
NGO	Non-Governmental Organization
NMCP	National Malaria Control Program
ODK	Open Data Kit
*Pf*PR	*Plasmodium falciparum* Prevalence
*Pf*SPZ	*Plasmodium falciparum* Sporozoite
PMI	President's Malaria Initiative
PSU	Primary Sampling Unit
RDT	Rapid Diagnosis Test
SBCC	Social Behavioral Change Communication
SOP	Standard Operational Procedure
SP	Sulphadoxine-Pyrimethamine
SRS	Simple Random Sampling
Swiss TPH	Swiss school of Tropical Public Health
TF	Travel Fraction
TFR	Total Fertility Rate
U5MR	Under Five Mortality Rate
USM	University of Southern Maine
WI	Wealth Index

FOREWORD

This report presents findings of the 2023 Bioko Island Malaria Indicator Survey (BIMIS) conducted on a representative sample of 4,998 households. The survey is implemented by MCD Global Health under the auspices of the National Malaria Control Program (NMCP) within the Ministry of Health and Social Welfare (MoHSW) of the Republic of Equatorial Guinea. This is a follow-up to previous surveys that have been conducted on the island since 2003. The survey provides updated estimates on population-based malaria indicators that complement other routine data to inform Bioko Island's strategic planning of malaria control.

The survey was designed to collect specific information on (1) malaria knowledge, attitude, and practice - (2) ownership, access, and use of long-lasting insecticide-treated net (LLIN) - (3) Intermittent Preventive Treatment in pregnancy using Sulphadoxine-Pyrimethamine (IPTp-SP) - (4) fever management in children aged less than five years - (5) malaria prevalence - (6) anemia among children age six months - 14 years and pregnant women. Blood samples were also collected on filter papers for molecular surveillance and further research on malaria. In addition, in 2023 a socio-economic module was added to the questionnaire to assess the socio-economic levels of the population and identify whether the distribution of malaria control activities is equitable. Finally, a birth history module was included in order to update estimates of the all-cause mortality rate in children under age five (most recent previous estimates are from 2018).

The NMCP is highly indebted to the various parties that contribute to the fight against malaria on Bioko Island and especially to the success of this survey. Special recognition to the government of Equatorial Guinea and private donors for continuously funding the fight against malaria on Bioko Island. Appreciations to MCD Global Health for restless commitment and efforts to free Bioko from malaria. Gratitude to the London School of Hygiene and Tropical Medicine (LSHTM) for technically assisting the implementation of control interventions and the organization of the MIS on Bioko for over 15 years. Acknowledgments to MCD´s staff for the front-line battle against malaria on Bioko Island and all other individuals who contributed to the survey's success. The NMCP thanks the administrative, local, and military authorities who granted access to the population, especially in times of restrictions imposed by the unprecedented COVID-19 pandemic. High appreciation to the survey participants for providing answers to the questions, adhering to malaria and anemia testing, and providing blood samples.

The NMCP, together with MCD, has the pleasure to present the findings of the 2023 MIS on Bioko Island and hope that all stakeholders, decision-makers, data users use these findings to contribute to improving the health of populations.

Sincerely,

Dr. Matilde Riloha Rivas
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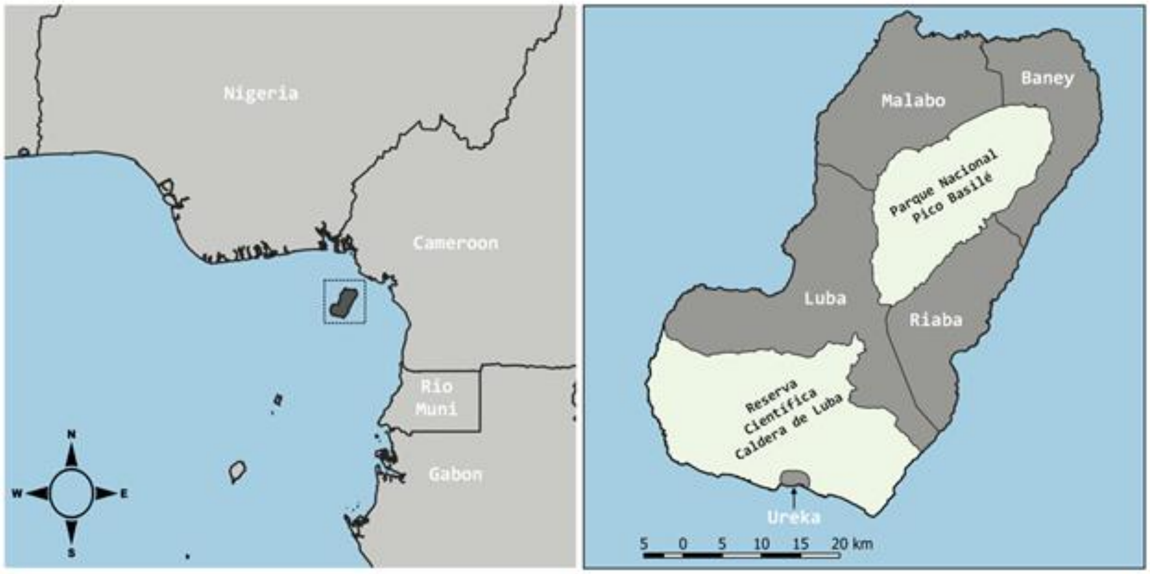
BIOKO ISLAND MAP



1 INTRODUCTION AND SURVEY METHODOLOGY

1.1 Brief presentation of Bioko Island

Bioko island, formerly Fernando Po, is located on the West African continent shelf, precisely in the Gulf of Guinea, and separated from Cameroon by no more than 32 kilometers of shallow ocean. With its total land surface of 2000 km^2, Bioko forms part of the nation of Equatorial Guinea. The rest of the country consists of a mainland part, Rio Muni, located between Cameroon and Gabon, and four other small islands: Annobon, Corisco, Elobey Grande, and Elobey Chico. Formerly a Spanish colony, Equatorial Guinea became independent in 1968; therefore, Spanish remains its primary language, even though French was later introduced as a second official language.

Bioko island is home to two of the six provinces of the Republic of Equatorial Guinea: Bioko Norte, divided into two districts, Malabo (the country's capital) and Baney, and Bioko Sur, also divided into two districts, Luba and Riaba. Bioko has two natural reserves, *Parque Nacional Pico Basilé* and *Reserva Científica caldera de Luba*. The original inhabitants of Bioko are the Bubi, descendants of Bantu migrants from the mainland, although significant numbers of mainlanders, mostly the Fang, colonized the island since the mid-1960s. Bioko was also home to Nigerian workers and Fernandinos, descendants of former slaves liberated by the British from Sierra Leone and Cuba.

Bioko island has a typical equatorial climate, with high temperatures, high humidity, and heavy rainfall.[1] The temperature in Malabo ranges from $16°^{C}$ to $33°^{C}$, meanwhile on the southern Moka plateau, average high temperatures are only $21°^{C}$. The primary wet season lasts between April and October, and annual rainfall varies from 193 cm in Malabo to 1,092 cm in Ureka, the extreme south point of the island.

1.2 Fundamental economic and demographic indicators

In the past, three commodities (cocoa, coffee, and timber) mainly sustained the economy of Equatorial Guinea. Because Bioko possessed the suitable soil and climate for intensive cultivation, the high-quality cocoa cultivated on the island was the primary source of the country's income. However, after the departure of Nigerian workers, cocoa and coffee production dropped significantly, and exports almost ceased. In the early 2000s, the petroleum business grew outstandingly to become the pillar of the country's economy. However, fishing and timber production on the mainland continued to contribute. Despite the considerable increase in its Gross Domestic Product (GDP) related to the petroleum business, the most significant proportion of Equatorial Guinea's population still lives under the threshold of poverty.

1.3 Malaria control on Bioko Island

Bioko island's population was estimated to be about 335,000 in 2015.[1] Of the total 97,000 households enumerated in 2018, almost 80% were located in the capital city of Malabo.[2] Bioko's population is relatively young, with nearly 15% less than five years old and 40% below 15 years old.[3,4] The male and female gender are balanced, and life expectancy at a national level is estimated to be 67 years for women and 65 years for men.[5]

1.3.1 General Overview

Because malaria is endemic on Bioko, with year-round transmissions, a public-private consortium was established between the government of Equatorial Guinea and petroleum businesses to sponsor the fight against malaria. These private partners included Marathon Oil Corporation, Noble Energy, Sonagas, GEPetrol, and Atlantic Methanol Company (AMPCO). As a result, the Bioko Island Malaria Control Project (BIMCP) was implemented in 2004 by Medical Care Development International (MCDI) under the auspices of the National Malaria Control Program (NMCP) within the Ministry of Health and Social Welfare (MoHSW). In addition, implementation received advisory and technical support from academic institutions, including the London School of Hygiene and Tropical Medicine (LSHTM), the Liverpool School of Tropical Medicine (LSTM), the Institute for Health Metrics and Evaluation (IHME) at the University of Washington, the Department of Computer Science of the University of Southern Maine (USM), the Texas A&M University (TAMU), and the Department of Global and Community Health at George Mason University (GMU).

At inception, the BIMCP conducted one to two annual rounds of indoor residual spraying (IRS) throughout the island as the primary intervention to curb malaria transmission. In 2015, the project changed its vector control strategy, introducing Long-lasting insecticide-treated nets (LLINs) across the island, while focalizing IRS deployment only to high-risk areas. In 2021, the strategy again changed, with a return of island-wide IRS (though at varying levels of coverage) and the implementation of LLIN pick-up points in Malabo. Starting in 2015, LLINs were also distributed to pregnant women during their antenatal care visits (ANC). Larval Source Management (LSM) was piloted in construction sites in 2013 to complement IRS and LLINs, and has been implemented in response to malaria outbreaks[6], and on a modest scale in 2021-2023. Additionally, the BIMCP established a malaria case management and diagnostics framework to support prompt and early diagnosis of suspected cases, appropriate treatment of confirmed cases, and prevention in pregnancy. Furthermore, a comprehensive Social and Behavioral Change Communication (SBCC) strategy was initiated to promote Knowledge, Attitudes, and Practices (KAP) towards malaria within the population.

The BIMCP built a robust Monitoring and Evaluation (M&E) system to support implementation and enable data-driven decision-making. Components of this system include the Geographic Information System (GIS) based mapping and enumeration of households on the entire island, vector monitoring, passive cases surveillance through the Health Information System (HIS), and the periodic evaluation of outcomes against targets through the annual Bioko Island Malaria Indicator Survey (BIMIS).

The BIMCP registered outstanding progress during the first 5-10 years of the project. Malaria transmission, anemia in children, all-cause U5MR, and Entomological Inoculation Rate (EIR) fell drastically.[3,4,7–9] Moreover, two of the four dominant malaria vector species, *An. funestus* and *An. gambiae* s.s. disappeared from the island.[10] Despite these notable victories, malaria transmission remains at moderate levels, as evidenced by prevalence estimates, incidence estimates, and their age distribution.[3,4,11]

Largely in response to the level of transmission remaining despite intense control efforts, the Equatorial Guinean Malaria Vaccine Initiative (EGMVI) was established in 2013 with a goal of testing the safety and efficacy of a whole, inactivated Plasmodium falciparum sporozoite (PfSPZ) vaccine. This live, attenuated, whole sporozoite vaccine manufactured by Sanaria Inc., with an established safety record and technical profile, was identified as a potential game-changer for malaria elimination on Bioko Island. The EGMVI established critical clinical research capacities in Equatorial Guinea necessary for a Phase III clinical trial through development of personnel, infrastructure, regulatory processes, an ethical committee, clinical laboratory, and a vision for a national research institute. Given the common goals of malaria elimination from Bioko Island, the EGMVI project merged with the BIMCP in 2019 to become the Bioko Island Malaria Elimination Project (BIMEP). As a result, new partners became involved in supporting implementation, including the Ifakara Health Institute (IHI), Sanaria Inc., and the Swiss Tropical and Public Health Institute (Swiss TPH). With the onset of the COVID-19 pandemic, however, vaccine-related activities were suspended indefinitely, and have not resumed.

1.3.2 Summary of vector control on Bioko Island in 2023

Indoor residual spraying (IRS) has significantly reduced malaria transmission on Bioko Island. However, IRS implementation is costly and requires highly trained personnel. Additionally, there is a lack of evidence supporting the 80% to 85% coverage recommended by the World Health Organization (WHO). Therefore, an appropriate strategy for IRS must balance the need for community protection and scarce resources. Furthermore, historical data on Bioko Island showed that IRS had almost similar effects in sectors sprayed at 50% coverage compared to those sprayed at 80% coverage. Based on these findings, suggesting the necessary coverage for effective malaria prevention may be lower than 80%, in 2021-2022 the BIMEP conducted an island-wide operational randomized cluster non-inferiority trial to compare the impact of 50% IRS coverage against the assumed threshold of 80%. Seventy-four clusters were defined, with 37 assigned to the 80% coverage trial arm and 37 to the 50% coverage arm. The primary outcome was the sector-level change in *Plasmodium falciparum* prevalence (PfPR) between 2020 and 2022 (2-years) and between 2020 and 2021 (1-year), using the 2020-2022 BIMIS data. Based on preliminary results of this study, in 2023 IRS targets were changed to 50% in urban Malabo (with the exception of some areas which were not targeted for IRS), and 80% or more outside Malabo. As a result BIMEP sprayed 31,032 houses between 6 March and 10 August 2023, protecting a population of 120,894, including 17,172 children under age five and 2,091 pregnant women.

Since 2015, LLINs have been a core component of vector control on Bioko Island. The BIMEP conducted the first LLINs mass distribution campaign on Bioko Island in 2015. In 2017, the BIMEP collaborated with the Ministry of Basic Education to organize a school-based distribution campaign during which pupils of all primary schools on Bioko Island received LLINs. For pregnant women, continuous distribution channels were maintained through ANC clinics in Government health institutions. The latest mass distribution campaign took place in 2018, followed by a top-up distribution in high transmission areas in 2020. However, besides efforts to sustain LLIN ownership on Bioko Island, historical data reveals high attrition rates and poor adherence to the intervention, especially in Malabo. Given the high cost (both in materials in personnel) of door-to-door distributions, in 2021 a new strategy was adopted: continue door-to-door distributions outside of Malabo, but stop community distributions in the greater Malabo area, and instead open LLIN pick-up points. In theory this should provide access to those who actually use LLINs, while minimizing use of resources to distribute nets that will not be used. As such, there was a mass distribution in 2021 to the areas outside of Malabo, while from 2021-2023 pick-up points have been active within Malabo. In 2023 no community distribution campaigns were conducted, but over the course of the year 53,083 LLINs were distributed in pick-up points, and 6,313 LLINs were distributed to pregnant women at ANC clinics.

1.4 The Bioko Island Malaria Indicator Survey

The aim of eliminating malaria worldwide encouraged the scale-up to measure key malaria indicators through nationally representative household surveys. Malaria indicator surveys (MIS) measure indicators related to the Roll Back Malaria (RBM) Global Malaria Action Plan, the Millennium Development Goals (MDG), and the President's Malaria Initiative (PMI) targets.[12] The first MIS was conducted on Bioko island in late 2004 as a benchmark. Since then, follow-up surveys have been conducted yearly during the high transmission (August to October) season.

The Bioko Island MIS (BIMIS) design has undergone several modifications over the years. Before 2015, samples were drawn from 18 areas on the island that served as sentinel surveillance sites. These sites were selected in part based on their higher transmission levels, but also covered the majority of the population. However, the availability of reliable census information in 2015 facilitated the expansion of the sample to the entire island, using communities as Enumeration Areas (EA). From 2015-2018, a somewhat complex sampling strategy was applied to maintain statistical power in the sentinel sites for historical comparison. From 2019 onwards, primary sampling units (PSUs) were defined based on map areas (1 km x 1 km grid cells)[2], since unlike communities map areas have consistent boundaries and thus reduce issues related to the Modifiable Areal Unit Problem (MAUP).

The survey questionnaire has been standardized to collect similar data each year, where possible using identical question prompts, with additional modules added as necessary. Initially, only children between the ages of 2 and 14 years were tested for malaria and anemia. However, starting in 2008 one random adult was included in malaria testing in each targeted household, and since 2012 all consenting household members present were tested for malaria.

In addition to the standard MIS, every five years the survey questionnaire has been extended to conduct a long economic survey. This involves adding modules to collect information on the expenses of households for a socioeconomic evaluation of the impact of malaria control activities, as well as incorporating a standard DHS birth history module for estimating fertility and childhood mortality rates. The 2023 questionnaire incorporated these modules, and the long economic survey was conducted on a subsample (approximately 10% of the sample), while reproductive histories were taken for women of reproductive age (15-49) in all households surveyed.

1.4.1 Survey Objectives

The objective of the 2023 BIMIS was to provide current estimates of population-based key malaria indicators, specifically:

- Key LLIN indicators including household ownership, household access, population access and use
- Coverage of preventative interventions for pregnant women, including ANC, LLIN use and IPTp
- Health-seeking behaviors for fever and treatment practices, in particular the use of antimalarial medications
- Diagnosis and treatment of children under age five in any health facility, clinic or pharmacy
- Prevalence of malaria
- Prevalence of anemia in children age six months to 14 years and pregnant women
- Knowledge of malaria and related attitudes and practices (KAP)
- Fertility and childhood mortality rates

1.4.2 Survey Questionnaire

The BIMIS questionnaire is adapted from the standard MIS toolkit developed by the Roll Back Malaria Monitoring and Evaluation Reference Group (RBM-MERG).[13,14] The BIMEP and the NMCP translated and adjusted the questionnaires into Spanish to match the local context. The 2023 BIMIS questionnaire was divided into three sections: the household section, the household members and visitors' sections, and the bed nets section. A single adult household member provided answers to the questions related to the household and all the other household members. In addition, women aged 15 – 49 responded to specific questions related to malaria prevention in pregnancy if they were present at the time of the survey and willing to participate.

The household section captured information on housing characteristics, knowledge, attitude, practice on malaria, and household assets (radio, television, cooker, washing machine, and others). The long economic survey modules were also incorporated into this section. After completing the household section, primary information about household members and short-term visitors was collected, including name, age, sex, and pregnancy status. This information determined eligibility for anemia testing, and to identify women of child-bearing age (15-49). Individuals who normally live in the household and others who slept in the household on the night preceding the survey and who had been living in the household for at least two weeks were classified as household members (i.e., permanent members), while those who do not normally live in the household but had slept there for a period of less than two weeks were classified as short-term visitors. After collecting this basic information, surveyors proceeded with malaria and anemia testing.

Once testing was complete, the interview continued with the household members and visitors' section. For each permanent household member, surveyors collected demographic information (age, sex, relation to the household head, level of education, and work status); recent travel history within or outside of Bioko Island; bed net use; history of illness in the last two weeks, and treatment-seeking behavior in the case of a recent fever; details of treatment for children under age five with a recent fever; COVID-19 vaccination status for residents age 18 or older; use of malaria in pregnancy prevention measures in the most recent pregnancy and birth history for the last 10 years for women of childbearing age; and malaria and anemia testing results. For short-term visitors, only basic demographic information (age, sex) and malaria testing results were collected.

The bed net section comprised the final stage of the interview, enumerating and collecting information on all bed nets present in the household. Where possible, surveyors observed the bed nets and classified them according to brand, color, physical condition, and source. Where observation was not possible the respondent was asked for this information. Finally, surveyors enumerated which bed nets were used by which household members and reasons for not using any other bed nets existing in the household on the night before the interview.

The BIMIS questionnaire was programmed into tablet devices, which enabled computer-assisted interviewing. Data were captured and processed using the Campaign Information Management System (CIMS). The CIMS is an in-house Android application that maintains a database of real-world entities, including an administrative and organizational hierarchy of provinces, districts, sub-districts, localities, map areas, and map-sectors, within which households are located. Using this system enables linking every survey to a household by its unique code, and thereby to a map-sector, map area, community, district and province.

The CIMS comprises two related applications, CIMS-Mobile and CIMS-Forms, and is used to identify and locate households targeted for interventions/surveying and capture data.[2,15] The CIMS-Mobile application has an interface through which authorized fieldworker logs in with a unique identifier and password. After logging in, the fieldworker selects an assigned module (MIS, IRS, LLIN, among others); and then navigates through the organizational hierarchy (province – district – sub-district – community – map area – map sector) to an assigned location (household) and launches a questionnaire (blank form). The CIMS-Forms application then takes control of data entry using Open Data Kit (ODK) software protocols.[16] In the background, the CIMS tags every form with a universally unique identifier (UUID), the unique fieldworker identifier, and data collection date and time.

1.4.3 Survey design and sampling strategy

As noted above, the sampling strategy for the BIMIS changed in 2019. Previously, survey samples were taken using communities as the primary sampling unit, but this became problematic for year-to-year comparisons because community boundaries often change, while higher-level administrative boundaries such as district do not provide sufficiently disaggregated data for detailed intervention planning. Given the existence of a relatively mature grid-based mapping system,[2] the logical choice was to begin using map areas for constructing the sample. However, many map areas are sparsely populated, so it was necessary to group map areas into primary sampling units (PSU). This was done using a fried-egg approach. First, map areas with at least 100 independent households were considered separate PSUs. Those with less than 100 households were joined with geographically contiguous (if possible) map areas, or their closest neighbors, considering the spatial distribution of houses within them. Based on this approach, a total of 109 unique PSUs were defined.

Given the observed heterogeneity in malaria prevalence and other related metrics, defining strata was also necessary to improve the quality of analysis. Previous work had already shown that recent travel off of Bioko Island was a significant risk factor for malaria.[4,17,18] When taken with the substantial geographic variation in frequency of off-island travel (much more common in urban Malabo than elsewhere), this suggested that observed malaria prevalence may not be the best metric to approximate local malaria transmission. Hence, a more robust analysis was performed using human mobility data collected in the BIMIS and malaria transmission models to infer the proportion of malaria infections which were attributable to local transmission (LRF, the local residual fraction).[19] Overall, the LRF was low in urban Malabo, and substantially higher in the rural areas outside of Malabo, in particular the west and southwest coasts. In fact, this distribution closely mirrored the population density, which is much higher in Malabo (with around 80% of the households) than the rest of the island.[2] Thus, each of the PSUs were assigned to one of two strata based on a composite score of population density and LRF:

- Stratum 1 (53 PSUs): low population density (< 250 inhabitants per km2) and high LRF (above median; LRF ≥ 7.6%)
- Stratum 2 (56 PSUs): high population density (≥ 250 inhabitants per km2) and low LRF (below median; LRF < 7.6%)

The resulting stratification framework is shown in Figure 1.1. For each PSU, the target sample size was defined as 25% of the total number of inhabited households in stratum 1, and 5% in stratum 2, in order to ensure sufficient power in stratum 1. To account for households which have become uninhabited since last visited by BIMEP, or which are not available to be surveyed, the sample size was increased by 30%. Using this increased sample size, households were selected in each PSU by simple random sampling. The resulting sample included 6,522 households (2,212 in stratum 1 and 4,310 in stratum 2), with a target of at least 5,010 to be surveyed (1,705 in stratum 1 and 3,319 in stratum 2), including 551 long economic surveys (193 in stratum 1 and 358 in stratum 2)

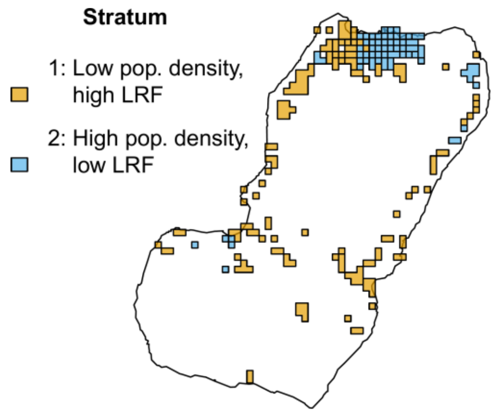


Figure 1.1: Map of PSU by stratum

1.4.4 Training of survey staff

Survey training took place between July 18 and August 3 at the Ministry of Civil Aviation in Malabo. Fieldworkers who had an excellent performance in previous activities organized by the BIMEP were selected and trained to be surveyors. Technical BIMEP staff with substantial field experience, including in vector control, GIS/operations, and previous surveys were selected and trained to be field supervisors and coordinators. In total, 64 people participated in the training. The BIMEP's Data Quality & Analytics team led the training with the support of other staff. Training consisted of classroom lectures, mock interviews in class and field, and field practice. The following topics were covered during classroom lectures:

- Map reading
- Overview of malaria and anemia
- Overview of M&E concepts applied to malaria programs and the importance of the BIMIS in decision making
- Ethical considerations when conducting a survey
- Map reading for fieldwork
- Survey material
- Completing the household members, birth history and visitors' rosters, the anemia and malaria referral forms, and signing the informed consent document
- Interview techniques
- Overview of the survey questionnaire

Throughout the training, significant time was dedicated to practical sessions. One group of practice sessions focused on improving familiarity with the questionnaire through mock interviews. A second set of sessions was dedicated to malaria and anemia testing, including: informed consent procedures, anemia testing with the HemoCue system, malaria testing using a Rapid Diagnostic Test (RDT), blood sample collection on filter papers, treatment referral procedures for positive malaria cases, and procedures to refer anemia cases for follow-up. For these sessions, students were grouped around workstations to practice malaria and anemia testing.

After training was completed, the survey was piloted on August 4 on a random sample of 300 households selected in the 4-1.2 Banapa I-Acrópolis community in Malabo. Pilot data were revised and discussed by the implementation team before launching the survey on August 5.

1.4.5 Survey deployment plan

The 2023 BIMIS deployment plan was developed using QGIS,[20] and Figure 1.2 shows an overview. In brief, deployment units were map sectors (virtual grids of 100 m x 100 m), which were grouped into four distinct clusters, A, B, and C of almost equal sizes located in Bioko Norte province, and P located in Bioko Sur province. The field team was similarly divided into three groups. Each group was assigned one of the three Bioko Norte clusters (A, B, or C), while cluster P was treated specifically and assigned to the entire survey group. Each group was composed of a field coordinator, two supervisors, twelve surveyors (six under each supervisor, of which four conducted the standard MIS and two worked as a team conducting the long economic survey), two drivers, and one survey nurse. Map sectors within each cluster were grouped into roughly equal sized work zones, which were then grouped into deployments. In order to ensure equity of workload, work zones with extended distances between inhabited map sectors had fewer households to survey. Overall, the distribution of work was:

- 1,538 households in cluster A, grouped into 152 work zones (2 – 23 households per zone; median: 9.5) and 19 deployments
- 1,404 households in cluster B, grouped into 88 work zones (4 – 35 households per zone; median: 12) and 11 deployments
- 1,477 households in cluster C, grouped into 127 work zones (1 – 27 households per zone; median: 10) and 16 deployments
- 605 households in cluster P, grouped into 72 work zones (2 - 19 households per zone; median: 8.5) and 3 deployments

Entry and exit dates from each deployment were estimated based on an anticipated average of 4 surveys completed per surveyor per day (2 surveys per day for the long survey teams), an attendance rate of 95%, an estimated five rainy days with no possibility of going to the field, and six labor days per week. Cluster P was surveyed in the last two weeks of the survey by the entire team.

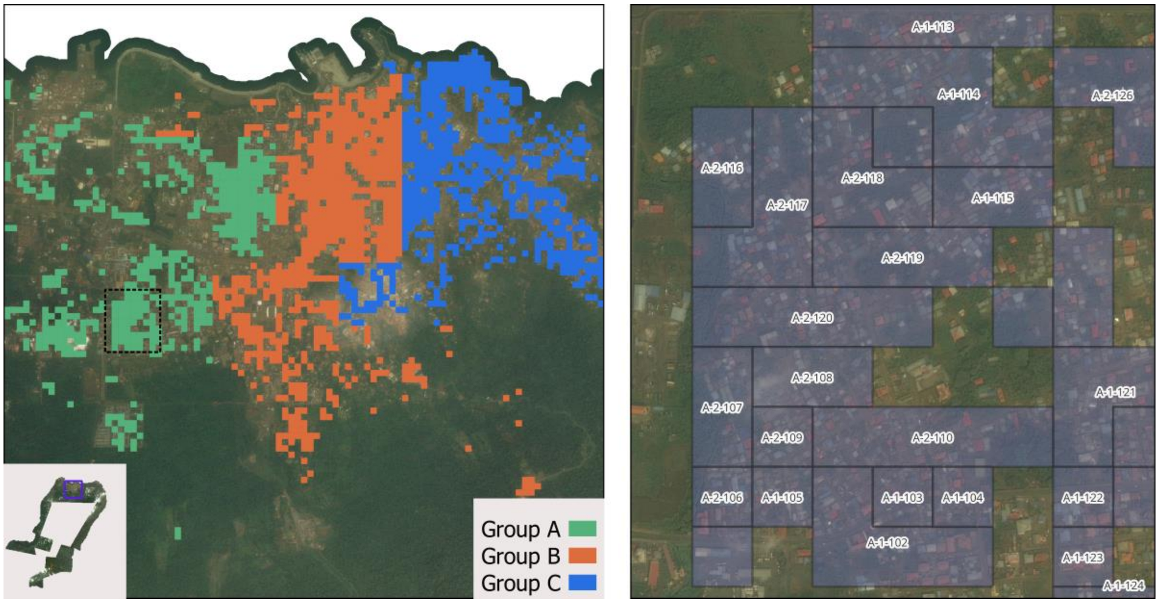


Figure 1.2: BIMIS deployment plan

Sectors in Bioko Norte were divided into three groups (left) and further into work zones (right). Work zones are named by the group (A, B or C) and supervisor (1 or 2) responsible, followed by the number of the zone for that supervisor (e.g. A-1-1)

1.4.6 Data collection

Thirty-six surveyors collected the data between August 5 and October 3. Before surveyors entered the field, data collection, the field coordinators sought authorizations from administrative, local, and military authorities of the respective districts, communities, and military barracks. The survey team visited the households six days weekly, from Monday to Saturday, between 8 AM and 4 PM. Due to lack of availability during these days and times, the work hours were changed on an *ad hoc* basis where necessary. Call-back visits were done on weekends to increase the chances of participation of the working class not present at home during busy hours. Surveyors used high-resolution paper maps to locate the assigned households in the field, using the NMCP/BIMEP door sticker for confirmation.[2] In case of missing or unreadable door stickers on the assigned household, neighboring households were used to guide confirmation. In the absence of the household members, three to four callback visits within at least 4 hours were done. Before anemia and malaria testing, surveyors carefully explained the procedures, risks and benefits, and the voluntary and confidential nature of the survey to the household members. The household heads or their designee duly signed the informed consent document to authorize children below 18 to be tested for malaria and anemia. All adult members and visitors willing to be tested for malaria and anemia also signed the informed consent document. Surveyors listed household members, and short-term visitors on the various rosters. Body temperature was also measured, and when possible, drops of blood were collected on filter paper for further investigations. The household head or a responsible household member provided answers to the questions related to the household and each member. Women aged 15 to 49 were also interviewed on malaria prevention in pregnancy, and their birth history since 2013.

1.4.7 Malaria and anemia testing

Blood samples for malaria and anemia testing were taken by finger-prick using a sterile lancet. One drop of blood was collected in a sterile microcuvette for anemia testing. Hemoglobin concentration was measured on-site with a battery-operated portable HemoCue® analyzer (HemoCue 801 AB, Angelholm, Sweden) providing results within 30 seconds. Participants with hemoglobin concentrations below 8g/dl were referred to a health facility for follow-up care.

Malaria was tested using the Standard Q Pf/PAN Ag Combo RDT (SD BIOSENSOR). Each test kit included a disposable sample applicator, an assay buffer solution, a disposable lancet, the testing device, and an alcohol swab that comes in a standard package. Practically, a small volume of blood was collected with the sample applicator and placed into the sample well on the testing device. Two drops of buffer were further added to the testing device's indicated well. The result was available within 15 minutes, and subjects who tested positive for malaria were offered age-appropriate doses of Artemether-Lumefantrine (AL).

When possible, additional drops of blood were collected on a Whatman 903™ protein saver card (GE healthcare Ltd, Forest farm, Cardiff, UK) from consenting participants and authorized children. The cards were uniquely barcoded, with a duplicate affixed to the corresponding RDT. The cards were air-dried in a dust-free environment, appropriately packed in gas-free zip lock bags with desiccant, and then stored at $-20^{\circ C}$ before shipment for lab analyses.

1.4.8 Data quality control, processing and validation

Completed and valid questionnaires were uploaded to the server using a wireless internet connection. Each survey was tagged unique identifiers for the surveyor who performed the interview, household where the survey was conducted, and date and time of the questionnaire creation to ease performance tracking and quality control. Tablets with completed questionnaires were transferred to the BIMEP office daily for quality control. Coordinators and supervisors carefully checked the data for inconsistencies and outliers, revised the informed consent forms for completeness of signatures, and checked the consistency of the barcode identifiers on RDTs and filter papers. The information on the household members and short-term visitors' rosters was scrutinized and compared with the data entered in the tablets. Contradicting information was investigated, discussed, corrected appropriately, and documented for follow-up and coaching. RDTs and filter papers were processed and stored following standard protocols. Completed surveys were finalized and uploaded to the server, and consent forms, rosters, and other field materials were stored appropriately. The repackaging team prepared consumables and materials for the next day, charged batteries and tablets, and synchronized the CIMS with the latest household database signature.

1.4.9 Fieldwork supervision

Supervisors used a checklist form to evaluate surveyors by direct observation (Appendix C). Similarly to the survey questionnaire, the supervision checklist was programmed to run using the CIMS. Supervisors evaluated all surveyors on their team once weekly on three sets of criteria: presentation to the household and consent administration, malaria and anemia testing, and survey questionnaire administration. Supervision data was analyzed, and follow-up was provided to poor-performing surveyors.

An online dashboard was programmed using Tableau to enable real-time monitoring of the survey and track the performance of surveyors. The dashboard was connected to views created on the BIMEP PostgreSQL server and described the overall survey metrics, field work progress, malaria prevalence, and productivity by fieldworkers. In addition, the implementation team held a weekly meeting to interpret and discuss the dashboard data in order to identify realistic solutions to sustain productivity and increase the performance (both in terms of productivity and quality) of the surveyors.

1.4.10 Ethical considerations

The protocol for the 2023 BIMIS was approved by the Ethical Review Committee (ERC) of Equatorial Guinea's MoHSW and the Institutional Review Board (IRB) of the LSHTM. Surveyors carefully explained related information to participants, as presented on the information notice (Appendix A). This information included: survey purpose, participation risks and benefits, and the voluntary and confidential nature of the survey. A signed authorization (Appendix A) was requested from the parents or legal guardians of children and adults before malaria and anemia testing and blood collection. Data access was restricted, and the names of the participants were removed from the final datasets before sharing. Malaria RDTs and filter papers were stored with barcode identifiers to protect participant confidentiality

1.4.11 Statistical analysis

Analysis of the survey data was performed using the R package .[21,22] For analysis, a two-level stratified cluster design was declared using PSU and household as clusters. Throughout this report, unless otherwise specified, estimates presented are weighted according to sampling probability. This is necessary because the sampling design preferentially sampled households in stratum 1 (Table 1.1), so crude estimates are not truly representative of Bioko Island. For each PSU, the sampling probability was set to 1 (i.e., a certainty PSU), and the household sampling probability was defined as the number of households sampled in a PSU divided by the number of inhabited households in that PSU, according to the sampling frame. In addition, a finite population correction was performed to account for the fact that all PSUs were sampled. A crude analysis was also performed (Appendix D contains a limited number of crude estimates) with a similar setup to the weighted analysis but setting the sampling probability for all households to the number of households sampled in the entire BIMIS divided by the number of households in the entire sampling frame. This falsely assumes that the sample is probabilistically representative of the island, but may be useful for comparisons since estimates presented in pre-2022 BIMIS reports were not weighted by sampling probability.

Table 1.1: Sampling by strata

Percentage of houses in sampling frame, sample, and among those surveyed which fall into each stratum

Stratum	Sampling Frame	Sample	Surveyed
1: Rural/high transmission	9.3%	33.9%	33.6%
2: Urban/low transmission	90.7%	66.1%	66.4%
Total households	**73,120**	**6,522**	**4,998**

Because of this analytical change, it is important not to directly compare the weighted estimates presented in this report with those presented in pre-2022 BIMIS reports. However, in order to provide consistent, comparable historical estimates survey data from 2004-2022 were also analyzed using probability weights. Sampling frames were available for all BIMIS since 2015, but not for 2004-2014. For these years, this analysis uses the 2015 health census as a sampling frame, following the approach adopted in previous historical analysis.[9] Probability weights and finite population corrections were defined as described above, but the PSU varied by year. From 2004-2015, sentinel sites were used as PSUs (without strata); for 2016-2018, communities were used and PSUs (without strata); and for 2019-2022 the stratified, map area-based PSUs described above were used.

2 CHARACTERISTICS OF POPULATION AND HOUSEHOLDS

Key Findings

- **Total fertility rate**: The total fertility rate was 3.4 births per woman during her lifetime, with age-specific fertility rates highest among women age 20-34
- **Child mortality**: The neonatal, infant and under 5 mortality rates were 9.8, 22.4 and 33.0 deaths per 1,000 live births, respectively

This chapter presents information on basic sociodemographic parameters, including the composition of the household population and wealth. Socioeconomic characteristics of the population are briefly presented, which comprise one important factor influencing the burden and treatment of malaria or other health conditions, as well as health-related behaviors. An overview of the demographics of survey respondents is included in the chapter, since these parameters (e.g. age, gender, education) are essential in interpreting key health indicators presented in later chapters. Finally, fertility and child mortality estimates are presented, which are important aspects not only of population demographics, but also (in the case of child mortality) important endpoints to assess the burden of malaria and impact of malaria control.

2.1 Population and household composition

Household

A person or group of related or unrelated persons who live together in the same dwelling unit(s), who acknowledge one male or female adult as their leader, who share the same housekeeping arrangements, and who are considered a single unit.

***De jure* household members**

All persons who are permanent residents of a selected household, regardless of whether they stayed in the household the night preceding the survey interview. Long-term visitors who had stayed in the house for at least the two weeks preceding the survey were considered permanent residents.

***De facto* household members**

De jure household members who stayed in a selected household the night preceding the survey interview.

The age and sex structure of the population is essential in interpreting health indicators, in particular the age-structure of the population can have significant implications for malaria prevalence. Table 2.1 describes the distribution of the *de jure* household population by 5-year age groups, according to sex and district of residence. In total 19,669 persons were registered in the 4,998 households surveyed, with valid age information for 19,523 individuals. Overall, the male and female population was well balanced, and very young (37.9% under age 15). Riaba and especially Luba districts had comparatively older populations than Malabo and Baney districts.

Table 2.1: Household population by age, sex and district

Percent distribution of the household population by 5-years age groups, according to gender and district of residence.

Age	Malabo			Baney			Luba			Riaba			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
<5	13.3	12.4	12.9	12.8	13.5	13.1	8.5	6.9	7.8	9.4	14.5	11.7	13.1	12.5	12.8
5-9	12.3	13.1	12.7	13.5	12.2	12.8	9.1	16.3	12.3	11.4	14.8	12.9	12.4	13.1	12.7
10-14	12.4	12.2	12.3	12.9	14.3	13.6	13.8	7.7	11.1	12.3	9.0	10.8	12.5	12.4	12.4
15-19	8.4	9.1	8.7	11.8	9.6	10.7	8.9	7.2	8.2	6.6	4.9	5.9	8.9	9.1	9.0
20-24	10.5	11.1	10.8	9.5	10.1	9.8	10.8	8.4	9.8	4.7	8.1	6.2	10.3	10.9	10.6
25-29	5.9	7.5	6.7	5.0	6.1	5.6	5.9	3.9	5.0	3.5	6.0	4.6	5.7	7.2	6.5
30-34	9.6	11.0	10.3	8.5	9.7	9.1	6.5	6.5	6.5	14.7	10.3	12.7	9.4	10.7	10.1
35-39	7.1	5.3	6.2	5.9	5.3	5.6	4.2	4.7	4.4	5.6	5.5	5.6	6.8	5.3	6.1
40-44	8.0	6.7	7.3	6.9	6.7	6.8	6.0	7.8	6.8	10.2	4.6	7.7	7.8	6.7	7.2
45-49	2.8	2.7	2.8	3.3	2.4	2.9	3.1	4.4	3.7	3.4	5.0	4.1	2.9	2.7	2.8
50-54	4.4	3.2	3.8	3.6	3.2	3.4	8.9	10.0	9.4	5.5	6.0	5.7	4.4	3.3	3.9
55-59	1.3	1.4	1.3	1.3	1.4	1.3	3.0	2.5	2.8	2.2	2.2	2.2	1.4	1.4	1.4
60-64	1.5	1.5	1.5	1.9	2.1	2.0	5.1	6.5	5.7	4.2	3.4	3.8	1.7	1.7	1.7
65-69	0.5	1.0	0.8	0.9	1.3	1.1	2.5	2.1	2.3	1.1	1.0	1.0	0.6	1.1	0.8
70-74	0.6	0.8	0.7	0.9	0.7	0.8	2.4	2.8	2.6	1.1	1.1	1.1	0.7	0.8	0.8
75-79	0.1	0.3	0.2	0.4	0.4	0.4	0.3	0.9	0.6	1.3	0.5	1.0	0.2	0.3	0.2
80+	1.2	0.7	1.0	0.9	0.8	0.8	1.0	1.4	1.2	2.8	3.0	2.9	1.2	0.8	1.0

The overall population distribution by age group and gender is shown in Figure 2.1. As in previous years, the population of Bioko Island was quite young, with a broad base and sharp peak to the population pyramid. Only 12.6% of the population was age 45 or older. The larger populations in ages 20-24, 30-34 and 40-44 compared to 25-29, 35-39 and 45-49 may be at least partially caused by respondents approximating age to the nearest round number (e.g. reporting 30 when true age is 28).

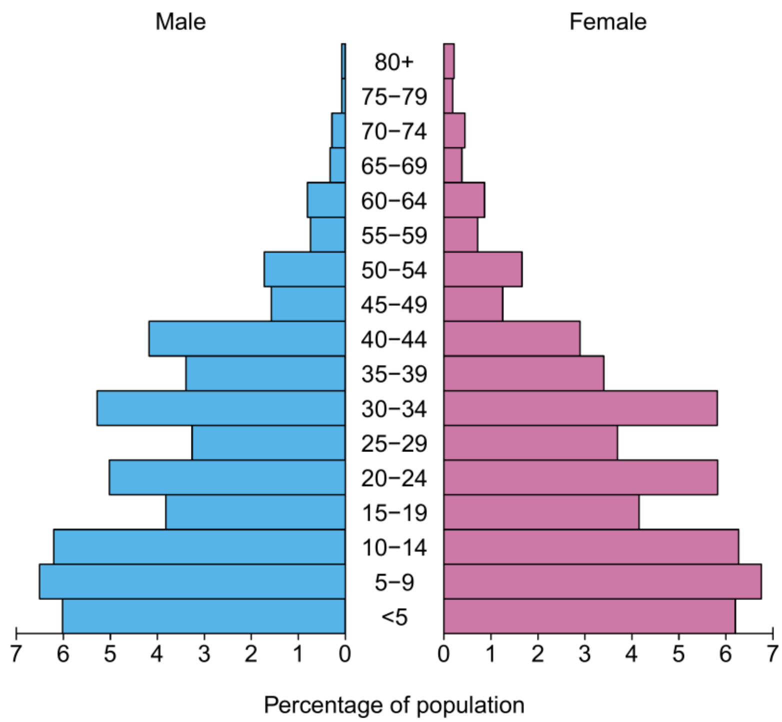


Figure 2.1: Population pyramid

Table 2.2 describes the household composition, including gender, age and education of household heads and household size by district of residence. In all districts, most households had a male head (overall 67.5%). In nearly all other respects, there was a clear difference in the characteristics of households in

Bioko Norte province (Malabo and Baney districts) and Bioko Sur province (Luba and Riaba districts). In Bioko Norte, most household heads were age 25-44 years, while in Bioko Sur there were more older heads of households, with the 55 or older group comprising the largest share. The mean household size was substantially higher in Bioko Norte (4-4.4 persons per household) than Bioko Sur (2.9-3.5 persons per household). Finally, for interpreting estimates presented in later chapters by stratum, it is important to note that households in Malabo and Baney overwhelmingly fall into the Urban/low transmission stratum, while Luba is well balanced between the two stratum and Riaba falls entirely into the Rural/high transmission stratum.

Table 2.2: Household Composition

Percent distribution of the households by characteristics of the household head (gender, age and education level) and household size by district.

	Malabo	Baney	Luba	Riaba	Total
Gender of household head					
Male	66.9	69.9	68.4	75.3	67.5
Female	33.1	30.1	31.6	24.7	32.5
Age of household head					
15-24	4.4	3.0	5.8	4.1	4.2
25-34	28.2	25.7	15.8	23.1	27.4
35-44	33.9	31.5	19.2	26.0	33.1
45-54	18.5	20.1	23.2	20.7	18.9
55+	15.0	19.6	36.0	26.0	16.4
Level of education of household head					
At most primary	9.5	9.3	25.5	30.7	10.3
Secondary	48.3	61.0	60.5	61.7	50.6
Post-secondary	42.2	29.6	14.1	7.7	39.1
Size of household					
1	20.1	15.1	33.9	25.9	20.0
2	15.7	15.0	20.1	20.5	15.8
3	14.7	12.8	13.2	12.2	14.4
4	12.3	14.2	11.2	14.6	12.6
5	10.5	12.5	7.9	8.6	10.7
6	9.0	11.9	7.0	8.2	9.3
7	6.6	5.5	3.5	2.8	6.3
8	4.1	5.5	2.4	1.1	4.2
9+	6.9	7.4	0.7	6.1	6.8
Stratum					
Rural/high transmission	6.7	6.0	54.5	100.0	9.3
Urban/low transmission	93.3	94.0	45.5	0.0	90.7
Mean household size	**4**	**4.4**	**2.9**	**3.5**	**4**
Total Households	**3,781**	**616**	**354**	**247**	**4,998**

2.2 Household possessions and Wealth Index (WI)

Wealth Index (WI)

Households are assigned a score using principal components analysis (PCA) based on the type of assets and amenities they own (radio, television, sofa, fan, air-conditioned, car, among others). This score provides a surrogate of socio-economic status (SES) and is used to rank households and group them into SES quintiles. The first quintile corresponds to households with the lowest wealth index (i.e., least wealthy) and the fifth to the highest (i.e., most wealthy). Based on the household they reside in, *de jure* household members were also assigned a wealth index quintile, though this represents the household they live in, and not necessarily their personal socio-economic status.

Ownership of domestic goods such as furniture, electronics, land and livestock provides one measure of comparative household wealth and general well-being, and can be used to construct a wealth index using principal components analysis. Table 2.3 summarizes ownership of household assets and crowding variable which were used in constructing the wealth index. Crowding was defined as having more household members than sleeping rooms, which provided a relatively balanced division. Most households had a television (87.2%), sofa (86.6%), telephone able to access internet (86.4%), stove (85.5%), refrigerator (84.7%) and table (84.8%), though households in Bioko Sur had lower ownership of nearly all items.

Table 2.3: Household possessions

Percentage of households possessing various amenities according to the district of residence.

	Malabo	Baney	Luba	Riaba	Total
Air-conditioning	34.2	33.5	9.7	4.2	33.0
Armoire	81.2	77.6	69.9	49.9	79.9
Bicycle	8.0	7.7	2.9	0.0	7.7
Boat	0.5	0.2	1.9	0.4	0.5
Cabinet	41.4	40.7	31.8	19.2	40.7
Car	29.9	33.5	17.9	11.6	29.8
Clock	24.1	26.6	18.0	10.3	24.0
Computer	31.3	26.1	10.4	5.9	29.6
Crowding	35.1	33.9	51.1	44.7	35.6
Fan	77.8	55.0	39.0	39.7	73.0
Motorcycle	1.5	1.4	1.0	0.0	1.4
Own household	47.4	64.7	57.0	59.4	50.2
Refrigerator	85.8	85.5	62.1	64.0	84.7
Sofa	87.1	88.3	72.3	66.5	86.6
Stereo	65.2	66.6	49.1	53.1	64.8
Stove	86.6	84.3	69.4	66.0	85.5
TV	88.5	86.7	64.4	60.1	87.2
Table	85.0	85.6	82.7	72.2	84.8
Telephone	88.8	82.1	51.4	59.3	86.4
Washing machine	36.5	38.8	16.3	10.6	35.8
Watch	68.7	57.7	48.7	32.5	66.1

Table 2.4 presents the distribution of households and *de jure* population by wealth index according to district of residence. Notably, Malabo and Baney households scored much higher in the wealth index, and more than 70% of households in Riaba were in the lowest two quintiles. Although the proportion of households in each quintile is nearly equal, the population distribution was not equal due to differing household sizes, with only 12.2% in the lowest quintile and 26% in the highest.

Table 2.4: Wealth quintiles

Percentage of household and *de jure* household population by wealth quintiles, according to the district of residence.

	Malabo	Baney	Luba	Riaba	Total
Households					
Lowest	18.3	20.9	44.9	55.4	20.0
Second	19.8	20.4	21.8	24.4	20.0
Middle	20.6	19.2	17.1	14.3	20.3
Fourth	20.9	16.8	9.9	4.8	19.8
Highest	20.3	22.7	6.3	1.1	19.9
Population					
Lowest	11.0	12.8	34.9	42.7	12.2
Second	17.4	20.4	20.3	27.9	18.0
Middle	20.9	18.2	21.6	21.3	20.5
Fourth	24.6	18.4	14.3	5.8	23.2
Highest	26.1	30.2	8.8	2.4	26.1

2.3 Characteristics of survey respondents

Table 2.5 presents the distribution of survey respondents by gender, age, education level and relationship to head of the household, according to district of residence. The majority of survey respondents were female (56.2%) and most were heads of household (57.8%). There were more respondents with a lower level of education in Luba and Riaba than Malabo and Baney, though in all districts most had attended secondary education. Corresponding to their older population, there were more older respondents in Luba and Riaba, while most respondents in Malabo and Baney were age 25-44.

Table 2.5: Respondent Characteristics

Percent distribution of the survey respondents by gender, age, education level and relation to household head by district.

	Malabo	Baney	Luba	Riaba	Total
Gender					
Male	43.8	38.3	46.5	49.4	43.2
Female	56.2	61.7	53.5	50.6	56.8
Age					
15-24	18.5	20.6	14.5	11.7	18.6
25-34	36.5	32.0	15.2	28.9	35.1
35-44	25.2	25.2	19.2	23.7	25.0
45-54	11.7	9.0	23.1	16.8	11.7
55+	8.2	13.3	28.1	19.0	9.6
Level of education					
At most primary	9.5	9.3	25.5	30.7	10.3
Secondary	48.3	61.0	60.5	61.7	50.6
Post-secondary	42.2	29.6	14.1	7.7	39.1
Relation to household head					
Head	57.8	46.1	67.6	63.4	56.6
Spouse	21.9	31.3	23.1	26.8	23.3
Child	9.6	12.3	7.0	3.6	9.8
Other	10.7	10.3	2.4	6.3	10.3

2.4 Fertility and child mortality

In addition to the current composition of the population, fertility and mortality rates are important to understand how this composition is changing over time. Additionally, child mortality is a key indicator for quantifying the burden of malaria and benefit of malaria control. Estimating fertility and child mortality through survey data requires the collection of reproductive histories from women of reproductive age (15-49 years). On Bioko Island, this has been added to the MIS questionnaire every five years, and was included in the 2023 questionnaire for all households. Missing or unknown birth dates of children were imputed according to DHS guidelines[23], and fertility and mortality rates estimated following the DHS Guide to Statistics[24].

Age-specific fertility rate (ASFR)

Average number of live births per year per 1,000 women in a particular age category over the three years preceding the survey.

Denominator: Years of exposure lived by women with completed reproductive histories in the age group of interest in the last three years

Total fertility rate (TFR)

Average number of times a woman will give birth during her reproductive life (age 15-49), assuming no change in current ASFR

Calculation: Sum of ASFR × duration of age category

In total, partial birth histories for the past 10 years were collected from 3,661 women in reproductive age, and 3,900 births registered. Age-specific fertility rates were calculated based on births in the three years preceding the survey, and were highest among women age 20-34 compared to younger and older age groups (Table 2.6). Based on these ASFR, the estimated total fertility rate was 3.4 births per woman over her lifetime. These fertility estimates are similar, but slightly lower than those reported in the 2018 BIMIS.[3]

Table 2.6: Age-specific fertility rates

Number of woman-years observed in reproductive histories, and corresponding fertility rate (births per 1,000 women per year) by age group

	Woman-years observed	Fertility rate
Age		
15-19	2,140	61.02
20-24	1,898	149.16
25-29	1,929	161.35
30-34	1,857	152.36
35-39	1,260	98.72
40-44	891	49.32
45-49	491	0.00

Neonatal, infant and under 5 childhood mortality

Deaths per 1,000 live births in the first month (neonatal), first year (infant) and first five years (under-5) of life.

Calculation: Computed by Kaplan-Meier survival estimator, which accounts for the time lived at risk at specific ages while computing survival probabilities

All-cause neonatal, infant and under-5 mortality rates (U5MR) were estimated from 2,245 births to women age 15-49 registered from 2018 onward, using the Kaplan-Meier survival estimator (Table 2.7). Overall, the neonatal mortality rate was 9.8 per 1,000 births, infant mortality was 24.4 per 1,000 live births and U5MR was 33.0 per 1,000 births. Infant mortality and U5MR were higher for male children than for female children, but neonatal mortality was similar across genders. The mother's age was also an important factor, with a (not statistically significant) trend of increasing likelihood of death in the first five years with decreasing age of the mother at birth. Childhood mortality also varied by geography, and was lowest in Baney (U5MR: 21.6) and highest in Riaba (U5MR: 65.1). Notably, these mortality rates are lower than was observed in the 2018 survey, indicating that there may have been a decline in childhood mortality in 2018-2023 as compared with 2014-2018.[3] However, because these are all-cause estimates, it is not possible to directly attribute this change to reductions in the burden of malaria, or any other particular disease or condition.

Table 2.7: Neonatal, infant and childhood (under-5) mortality

Rate of deaths per 1,000 live births in the first month (neonatal), first year (infant) and first five years (under 5) of life by age of mother at birth, gender of child, birth order, household wealth, district of residence and stratum

	Neonatal mortality	Infant mortality	Under 5 mortality	Births registered
Mother's age at birth				
< 20	12.2 (0.0-25.1)	29.2 (0.9-30.6)	43.2 (5.5-79.4)	277
20-29	11.4 (7.2-21.8)	27.7 (16.2-38.6)	34.7 (21.8-47.5)	1,194
30-39	7.5 (1.3-14.7)	26.7 (10.1-37.4)	27.4 (12.6-42.0)	702
40-49	6.1 (0.0-14.2)	6.1 (0.0-14.2)	6.1 (0.0-14.2)	72
Gender				
Female	10.3 (4.3-18.3)	19.8 (8.4-28.0)	26.3 (13.7-38.8)	1,085
Male	10.7 (6.0-18.8)	30.2 (18.7-41.0)	39.2 (24.9-53.3)	1,160
Birth order				
1	13.5 (5.1-21.8)	21.7 (9.6-30.0)	33.5 (17.4-49.4)	832
2	11.2 (3.3-19.6)	30.0 (15.6-43.4)	34.2 (19.4-48.8)	767
3+	7.2 (2.3-18.1)	27.6 (10.0-37.9)	28.6 (12.9-44.1)	646
Wealth quintile				
Lowest	15.8 (0.2-31.1)	21.8 (2.7-37.7)	21.8 (4.0-39.4)	330
Second	11.2 (2.9-24.5)	32.2 (13.4-49.5)	53.6 (24.6-81.8)	473
Middle	14.1 (1.2-21.3)	35.1 (12.1-51.1)	35.6 (14.8-55.9)	525
Fourth	7.4 (1.6-21.1)	25.0 (5.9-35.3)	35.4 (12.6-57.8)	463
Highest	9.1 (0.0-17.4)	15.1 (2.5-25.9)	15.1 (3.2-27.0)	454
District				
Malabo	10.6 (6.4-16.8)	25.9 (16.5-33.3)	34.3 (23.2-45.3)	1,757
Baney	8.3 (0.0-24.9)	21.6 (0.4-42.3)	21.6 (0.4-42.3)	282
Luba	18.0 (0.0-51.5)	42.2 (0.0-51.5)	42.2 (0.0-96.4)	93
Riaba	28.0 (0.0-43.3)	28.0 (0.0-43.3)	65.1 (2.5-123.8)	113
Stratum				
Rural/high transmission	19.8 (9.3-33.8)	29.6 (13.2-43.1)	45.2 (24.4-65.6)	715
Urban/low transmission	9.0 (5.7-15.9)	24.7 (15.6-32.0)	31.7 (21.2-42.1)	1,530
Total	**9.8 (7.2-16.6)**	**24.4 (16.7-31.8)**	**33.0 (23.3-42.6)**	**2,245**

3 MALARIA PREVENTION

Key Findings

- **Household ITN ownership and access:** 44.8% of households on Bioko Island owned at least one ITN, and 28.1% owned at least one ITN for every two *de facto* members
- **Population access to ITNs:** 38.3% of the population had access to an ITN, assuming that one ITN serves two individuals
- **ITN use:** 33.7% of the *de facto* household population, including 41.0% of children under age five slept under an ITN the night preceding the survey
- **Vector control coverage:** 68.8% of households owned at least one ITN and/or received IRS in the 12 months preceding the survey and 59.8% owned at least one ITN per two *de facto* residents and/or received IRS in the 12 months preceding the survey
- **Prevention in pregnancy:** 33.7% of pregnant women slept under an ITN the night preceding the survey and 40.5% of women who gave birth in the last two years received at least three doses of IPTp-SP during their last completed pregnancy

This chapter presents results on some key malaria control indicators on Bioko Island, including household ownership of, population access to, and use of insecticide-treated bed nets (ITN), overall vector control coverage, and coverage of malaria prevention in pregnancy.

Due to a lack of acquired immunity, the burden of malaria in holoendemic areas such as Bioko Island is highest in children under age five, who are more likely to experience severe malaria with life-threatening symptoms such as coma, respiratory distress and severe anemia.[25] Similarly, pregnant women are a vulnerable group with elevated risk for serious complications for both the mother and fetus. Particularly in a woman's first and second pregnancies, if infected with malaria she is more likely to have placental malaria (i.e., parasite sequestration in the placenta) and thus also anemia. These conditions in turn increase risk for low birth weight, premature birth, and intrauterine growth retardation, thus increasing the risk for neonatal and infant mortality.[26] Given these risks, effective prevention of malaria is particularly important among children under age five and pregnant women. For this reason, particular attention is paid to the coverage of malaria prevention interventions among these groups.

3.1 Household ownership and access to Insecticide-Treated Nets

Ownership of insecticide-treated nets (ITN)

Percentage of households that have at least one insecticide-treated net (ITN)

Denominator: Number of households

Household ITN access

Percentage of households that have at least one ITN for every two *de facto* household members

Denominator: Number of households with at least one *de facto* member

ITNs are physical barriers against mosquito bites that also repel and kill mosquitoes and thus are an important tool to reduce malaria transmission. Importantly, ITNs provide both personal protection to those sleeping under nets, as well as community protection (i.e., provide protection even for those who do not use ITNs) when high coverage is achieved.[27,28]

Given the fact that many people may spend a small (or large) number of nights sleeping away from home, or with visitors in their home, it is important to define a clear denominator to calculate ITN access and use indicators. Here, we use the *de facto* surveyed population, that is, individuals who reported sleeping at home the night preceding the survey, or for household-level indicators the number of households where at least one member reported sleeping at home the night preceding the survey. Of the 4,998 households surveyed, 4,862 reported having at least one member sleep at home the previous night, for a total *de facto* surveyed population of 17,662. Table 3.1 details household ownership of mosquito nets and ITNs on Bioko Island. Around half of households owned at least one ITN (44.8%), while substantially fewer had full access to ITNs (28.1%). Ownership and access varied by district, with Malabo and Baney having lower access compared to Luba and Riaba, even though there have not been ITN distribution activities in Bioko Sur since 2021. In general, there was little to no difference between ownership and access of ITNs and untreated nets (i.e., the vast majority of nets were ITNs).

Table 3.1: Household ownership of ITNs

Percentage of households with at least one bed net of any type (treated or untreated), percentage of households with at least one insecticide-treated net (ITN), average number of nets and ITNs per household, and percentage of households with adequate access to nets and ITNs, by district of residence and wealth quintile. adequate access to nets is defined as having at least one net per two *de facto* members, so households with no *de facto* members are excluded from this calculation

	Household owns net (%)		Mean number of nets per household		Households surveyed	Household has access to nets for all members (%)		Households with at least one person who stayed the previous night
	Any net	ITN	Any net	ITN		Any net	ITN	
District								
Malabo	50.2	44.8	1.10	0.94	3,781	32.6	27.6	3,693
Baney	44.1	41.8	1.08	1.00	616	28.5	26.4	599
Luba	60.2	57.2	1.36	1.29	354	49.9	46.4	332
Riaba	49.1	47.1	1.06	0.98	247	38.0	36.4	238
Wealth Quintile								
Lowest	46.5	42.5	0.76	0.68	1,216	36.1	32.5	1,152
Second	51.8	46.9	1.11	0.95	971	35.6	30.2	949
Middle	57.9	53.2	1.28	1.11	955	36.9	31.8	930
Fourth	52.6	47.8	1.36	1.22	938	32.5	28.0	919
Highest	39.7	33.6	1.01	0.83	918	22.2	18.2	912
Gender of household head								
Male	48.1	43.4	1.04	0.90	3,428	30.7	26.9	3,332
Female	53.0	47.7	1.23	1.07	1,570	36.6	30.7	1,530
Age of household head								
15-24	33.9	30.8	0.55	0.49	208	24.6	20.2	194
25-34	38.2	32.7	0.68	0.56	1,303	24.2	19.9	1,264
35-44	49.9	44.3	1.07	0.91	1,608	29.9	24.9	1,569
45-54	57.7	53.9	1.45	1.29	947	38.0	34.0	925
55+	63.5	59.0	1.63	1.47	932	47.7	43.1	910
Education of household head								
At most primary	63.7	56.5	1.36	1.14	531	50.5	42.3	516
Secondary	50.1	45.8	1.14	1.01	2,036	36.2	31.3	1,960
Post-secondary	40.6	35.8	0.86	0.72	1,443	23.7	20.5	1,405
Unknown	57.3	51.5	1.30	1.14	915	31.2	26.9	909
Stratum								
Rural/high transmission	49.6	45.2	1.08	0.96	1,677	36.5	32.6	1,609
Urban/low transmission	49.7	44.8	1.11	0.96	3,321	32.2	27.6	3,253
Total	**49.7**	**44.8**	**1.10**	**0.96**	**4,998**	**32.6**	**28.1**	**4,862**

As Figure 3.1 shows, both household ownership and access to ITNs have been gradually decreasing since the last island-wide mass distribution campaign in 2018. 2020 is a notable exception to this trend, explained by the top-up campaign conducted in high-transmission areas, including parts of the greater Malabo area. However, the subsequent mass distribution conducted outside urban Malabo in 2021 does not substantially impact island-level indicators due to the low population of the areas targeted. Overall, household ownership and access to ITNs in 2023 was slightly higher and lower, respectively, than the nadir reached in 2017 two years after the mass distribution campaign in 2015. The implementation of fixed distribution points may be one factor that helped to limit declines in ownership and access to ITNs.

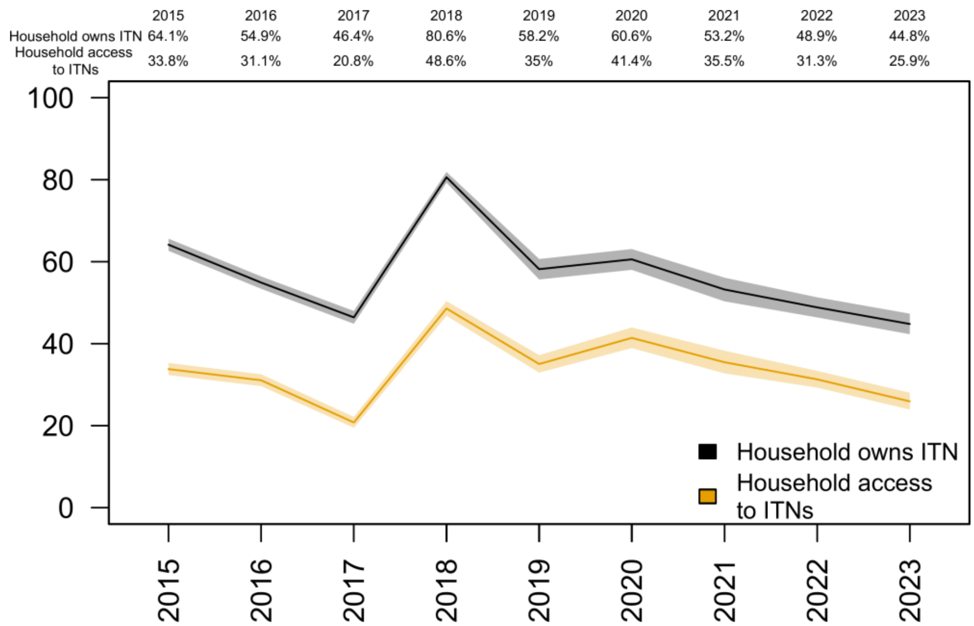


Figure 3.1: Historical trends in household ownership and access to ITNs

Percent of households which owned at least one ITN, and which had adequate access to ITNs for all members, that is, at least one ITN for every two household members. Access is based on the *de jure* population here, since de facto household population has only been collected since 2019.

3.2 Population access and use of ITNs

Population ITN access

Percentage of the *de facto* population that had access to an ITN if each ITN in the household was used by up to two people.

Denominator: *De facto* household population

ITN use

Percentage of the *de facto* population who slept under an ITN on the night preceding the survey.

Denominator: *De facto* household population

ITN use:access

Ratio between ITN use and ITN population access, which approximates the percentage of the *de facto* population with access to an ITN that used an ITN the night preceding the survey. However, ITN use:access can take a value greater than 100 in the case that, on average, more than two people used an ITN.

3.2.1 Population ITN access

Population access to ITNs estimates the proportion of the total population that could have slept under an ITN, assuming no more than two people use each ITN. Population ITN access varied little within Bioko, with only Luba district standing out as having increased access, compared to other districts (Table 3.2).

Access to ITNs was also consistent across wealth quintiles, with the exception of the wealthiest quintile, where access was much lower (25.9% compared to 40.5-44.9% in the other four quintiles). This may be related to higher housing quality and/or ownership of air conditioning in this group, reducing the perceived need for bed nets. Similarly, households headed by individuals with higher education levels had lower levels of access.

Table 3.2: Population access to bed nets

Percentage of the *de facto* population with access to any net or an ITN, by district of residence, household wealth and stratum. Access is defined as having a net in the household which would be shared with no more than one other person

	Access to any net (%)	Access to ITN (%)
District		
Malabo	44.3	38.2
Baney	39.6	37.2
Luba	51.7	49.0
Riaba	42.0	39.3
Wealth Quintile		
Lowest	44.7	40.5
Second	47.8	42.1
Middle	51.0	44.9
Fourth	47.5	42.3
Highest	31.3	25.9
Gender of household head		
Male	42.7	37.3
Female	45.9	40.3
Age of household head		
15-24	34.5	30.4
25-34	35.3	28.7
35-44	42.3	36.7
45-54	47.5	42.9
55+	53.0	48.1
Education of household head		
At most primary	61.1	51.2
Secondary	46.0	41.2
Post-secondary	36.0	30.7
Unknown	44.0	38.9
Stratum		
Rural/high transmission	43.0	38.2
Urban/low transmission	43.8	38.3
Total	**43.7**	**38.3**

3.2.2 Use of ITNs

The use of mosquito nets, especially by members of high-risk groups, is an important measure to protect against malaria. The 2023 BIMIS collected mosquito net use information for all *de facto* household members (Table 3.3). Of the total household population, 33.7% slept under an ITN the night before the survey, including two thirds (66.6%) of those in households with at least one ITN, and nearly four in five (79.9%) of those in households with access to ITNs for all *de facto* members. As with access, ITN use was similar across districts, and decreased significantly with increasing household wealth and education level of the head of household. ITN use also varied notably by age, with individuals age 5-44 using ITNs less often (26.5-35.5%) than young children (41.0%) or older adults (41.1-43.3%).

Table 3.3: Use of bed nets in the general population

Percentage of the *de facto* population who slept under a bed net (treated or untreated) or an insecticide-treated net (ITN) the night before being surveyed in all households, households with at least one ITN, and households with full access to ITNs (i.e., at least one ITN per two *de facto* members), by age, gender, education level of household head, district of residence, household wealth and stratum.

	All households			Households with at least one ITN			Households with full access to ITNs		
	any net (%)	ITN (%)	# individuals	any net (%)	ITN (%)	# individuals	any net (%)	ITN (%)	# individuals
Age									
<5	47.2	41.0	2,296	79.2	74.8	1,231	87.2	86.1	411
5-14	38.0	35.5	4,342	67.8	65.9	2,279	84.6	84.0	874
15-24	30.0	27.8	3,239	57.9	55.7	1,577	76.0	75.6	718
25-34	29.7	26.5	2,771	67.5	65.3	1,114	76.2	75.2	587
35-44	36.5	32.9	2,273	72.5	69.3	1,085	79.7	78.5	612
45-54	44.3	41.1	1,166	75.8	73.5	659	83.6	81.5	438
55+	46.8	43.3	1,182	75.3	73.0	708	81.9	80.1	515
Gender									
Female	39.3	35.7	8,654	71.2	68.3	4,446	82.9	81.8	2,067
Male	34.6	31.7	8,615	66.9	64.7	4,207	78.8	77.9	2,088
Household head education level									
At most primary	50.0	46.6	1,459	75.6	74.5	907	83.2	83.1	545
Secondary	39.6	36.4	6,578	73.0	69.9	3,335	82.7	81.7	1,821
Post-secondary	28.6	25.4	4,969	62.4	59.9	2,085	75.7	74.0	805
Unknown	39.5	36.1	3,967	68.1	65.8	2,126	82.6	81.4	899
District									
Malabo	37.8	34.1	13,298	69.7	66.8	6,699	81.5	80.4	3,067
Baney	32.6	31.2	2,301	66.9	65.8	1,089	79.3	78.8	550
Luba	39.5	37.8	869	66.1	65.7	463	74.0	73.8	299
Riaba	34.4	31.8	801	65.9	63.6	402	81.0	80.3	239
Wealth Quintile									
Lowest	40.8	38.6	2,625	78.3	77.6	1,333	81.2	81.1	812
Second	43.1	40.3	3,160	75.4	73.5	1,709	84.0	83.2	820
Middle	45.0	40.8	3,439	70.3	67.2	2,044	85.2	84.2	903
Fourth	41.0	38.0	3,809	71.2	68.6	2,022	81.6	80.8	961
Highest	21.5	17.8	4,236	52.5	48.9	1,545	70.2	67.8	659
Stratum									
Rural/high transmission	34.5	31.4	5,388	67.8	65.5	2,605	78.9	78.1	1,384
Urban/low transmission	37.2	33.9	11,881	69.3	66.7	6,048	81.1	80.1	2,771
Total	**37.0**	**33.7**	**17,269**	**69.1**	**66.6**	**8,653**	**80.9**	**79.9**	**4,155**

Patterns in ITN use among children less than five years old (Table 3.4) were similar to those in the general population. ITN use in this group is particularly important for decreasing the morbidity and mortality of malaria, since young children are a highest risk for severe malaria and resulting death. In total, 41.0% of children in this age group slept under an ITN, and nearly half slept under any bed net (47.2%). This varied by stratum, with rural areas having lower use of bed nets among children, and was especially low in Riaba district (27.8%). This trend is particularly concerning given that young children in high transmission areas are one of the groups most likely to develop serious complications, and potentially die, from malaria.

Table 3.4: Use of bed nets among children under age five

Percentage of children under age five who slept under a bed net (treated or untreated) or an insecticide-treated net (ITN) the night before being surveyed in all households, households with at least one ITN, and households with full access to ITNs (i.e., at least one ITN per two *de facto* members), by age, gender, education level of household head, district of residence, household wealth and stratum.

	All households			Households with at least one ITN			Households with full access to ITNs		
	any net (%)	ITN (%)	# individuals	any net (%)	ITN (%)	# individuals	any net (%)	ITN (%)	# individuals
Age in months									
<12	67.4	54.8	475	90.6	82.9	298	90.3	86.0	95
12-23	46.1	39.3	460	80.3	75.8	234	88.3	87.9	78
24-35	39.8	36.1	442	75.5	72.3	217	89.2	89.2	69
36-47	42.6	37.5	420	72.2	68.6	227	85.0	85.0	90
48-59	40.5	37.5	499	74.4	72.4	255	83.2	83.2	79
Gender									
Female	47.6	41.3	1,136	78.9	74.9	608	86.3	85.5	197
Male	46.8	40.8	1,160	79.5	74.7	623	88.1	86.7	214
Head of household education level									
At most primary	54.6	48.6	173	81.4	78.4	107	88.7	88.7	45
Secondary	48.3	42.9	857	83.5	77.9	445	90.6	89.9	172
Post-secondary	41.3	33.7	640	72.6	68.6	309	79.2	77.6	83
Unknown	50.0	44.1	583	79.9	76.1	336	91.2	89.3	101
District									
Malabo	48.6	41.9	1,808	79.6	74.7	994	87.8	86.5	321
Baney	41.7	37.8	304	78.5	76.8	146	84.9	84.9	53
Luba	39.4	36.9	84	74.4	72.7	44	81.0	81.0	18
Riaba	32.7	27.8	100	62.9	58.7	47	88.4	88.4	19
Wealth Quintile									
Lowest	54.4	50.3	302	88.6	86.3	172	96.8	96.8	55
Second	49.2	45.7	455	83.3	79.9	256	84.6	84.6	84
Middle	55.2	48.9	489	79.3	75.1	310	94.1	92.9	99
Fourth	49.6	44.7	520	80.6	77.4	286	85.8	84.2	105
Highest	33.0	22.5	530	65.8	56.9	207	76.3	74.1	68
Stratum									
Rural/high transmission	41.7	35.3	736	75.3	71.2	368	93.6	92.2	143
Urban/low transmission	47.7	41.6	1,560	79.5	75.1	863	86.5	85.5	268
Total	**47.2**	**41.0**	**2,296**	**79.2**	**74.8**	**1,231**	**87.2**	**86.1**	**411**

More than two in three nets owned by households were used the night preceding the survey (Table 3.5). However, this was lower in the rural stratum (61.1%) than the urban stratum (69.9%), which may partly be explained by the more recent mass distribution conducted in these areas (in 2021, compared to 2018 in urban Malabo). A greater proportion of untreated nets (75.6%) were used than of ITNs (68.7%), likely because ITNs were received free of charge while untreated nets were purchased, and those who purchase a net of any type are more likely to use it. Interestingly, in contrast to population use of nets, the proportion of nets used was consistent by household wealth and education of the household head. This provides some evidence of self-selection for net ownership, whereby those who use nets are more likely to keep the nets they receive than households or individuals who do not use nets. In an environment with pick-up points, this is intensified since individuals who do not want to use nets are unlikely to spend resources to visit the distribution point to receive nets. Self-selection of net ownership has important implications when considering future ITN distribution or communication activities, since it means net use among households that do not currently have nets is unlikely to reach the level currently observed in households with nets, even if perfect access were achieved.

Table 3.5: Use of existing bed nets

Percentage of existing bed nets which were used the night preceding the survey by net type, district of residence age, gender and education level of the household head, household wealth, stratum.

	Nets used (%)	Number of nets
Net type		
LLIN	68.7	4,792
Untreated	75.6	420
District		
Malabo	70.9	4,119
Baney	65.7	659
Luba	42.5	443
Riaba	57.8	262
Age of household head		
15-24	57.5	119
25-34	66.8	854
35-44	72.1	1,699
45-54	70.2	1,355
55+	66.4	1,456
Gender of household head		
Male	70.0	3,534
Female	67.4	1,949
Education of household head		
At most primary	68.2	689
Secondary	67.2	2,258
Post-secondary	67.6	1,255
Unknown	75.3	1,178
Wealth quintile		
Lowest	71.8	1,016
Second	72.3	1,110
Middle	70.2	1,230
Fourth	70.8	1,209
Highest	60.1	918
Stratum		
Rural/high transmission	60.1	1,820
Urban/low transmission	69.9	3,663
Total	**69.1**	**5,483**

3.2.3 Net use:access ratio

The ratio between use of bed nets and population access to bed nets (use:access) can be used as an approximation of the proportion of those with access to nets that use those nets. This is a key piece of information in evaluating and planning future ITN distribution strategies, since it can provide some information about what net use could be given perfect access. In the case of low use:access (i.e., a large gap between population access and use of ITNs), malaria programs may need to investigate drivers or barriers to ITN use and emphasize designing appropriate behavioral change interventions. However, a large caveat here is that since access estimates are based on survey data and not distribution data, the data may be subject to the net ownership self-selection effect discussed above. Thus, particularly in an environment with ITN pick-up points, net use:access likely overestimates the true willingness of the population to use nets given access.

Table 3.6 shows use:access ratios by various demographic breakdowns. Almost nine of every ten individuals who had access to an ITN used it the night preceding the survey. Notably, use:access was highest in Malabo and Baney districts, but still high in Riaba (0.81), and only slightly lower in Luba district (0.77). This trend is likely driven at least in part by the presence of ITN pick-up points in Malabo, intensifying the self-selection effect in urban areas of Malabo and Baney districts.

Table 3.6: Net use:access ratio

Ratio between net use (percentage of the *de facto* population using a net) and the proportion of the *de facto* population with access to any net or an ITN, by district of residence, household wealth household head education level and stratum. Access is defined as having at least one net per two *de facto* household members, so a value of 1.0 corresponds to every net being used on average by two persons.

	Any net	ITN
District		
Malabo	0.85	0.89
Baney	0.82	0.84
Luba	0.76	0.77
Riaba	0.82	0.81
Wealth Quintile		
Lowest	0.91	0.95
Second	0.90	0.96
Middle	0.88	0.91
Fourth	0.86	0.90
Highest	0.69	0.69
Education of household head		
At most primary	0.82	0.91
Secondary	0.86	0.88
Post-secondary	0.79	0.83
Unknown	0.90	0.93
Stratum		
Rural/high transmission	0.80	0.82
Urban/low transmission	0.85	0.89
Total	**0.85**	**0.88**

3.2.4 Trends in ITN population access and use over time

As noted above, there have been changes in the ITN distribution strategy in recent years, particularly since the most recent mass distribution campaign in 2018. Trends in key ITN indicators since 2015 (Figure 3.2) are important in evaluating whether these changes to the distribution strategy are working well. Although ITN ownership, access and use were very high in 2018 (due to that year's mass distribution campaign), these quickly declined in 2019. Since 2020, access to ITNs has declined modestly, likely due to a lack of mass distribution campaigns, but importantly ITN use has not. Correspondingly, there has been an increase in the use:access ratio, particularly since 2022. This could indicate that the change in strategy from mass distribution campaigns to pick-up points in Malabo is successful in providing ITNs to those who use them, and avoids spending resources on distributing nets to households unlikely to use them. Nevertheless, comparisons with 2018 when ITN use was substantially higher (54.4% compared to 33.7-37.6% in 2019-2023) cast some doubt on this interpretation.

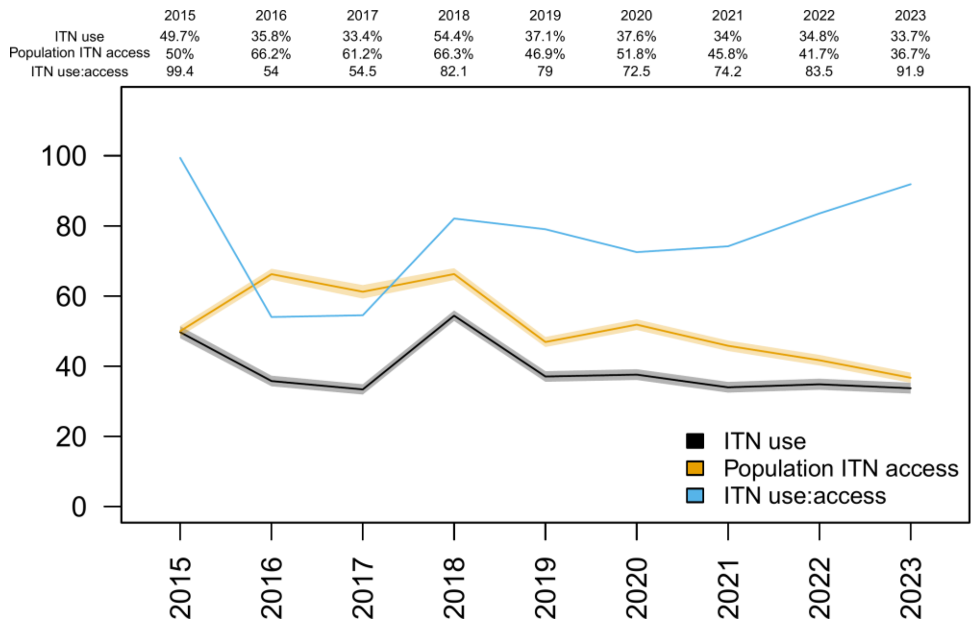


Figure 3.2: Historical trends in ITN population access, use, and use:access

Population access to ITNs, use of ITNs, and ratio between use and access (use:access) since 2015. Note that population access to ITNs, ITN use and use:access are based on the *de jure* population here, since *de facto* household population has only been collected since 2019. The use:access ratio has been multiplied by 100 and can be interpreted similar to percentages, but values above 100 are possible, corresponding to more than two persons using an ITN on average.

Perhaps more importantly, trends in net indicators are not uniform across the island. At the district level, it becomes clear while ITN use has remained stable in Malabo and Baney districts, since 2021 Luba and Riaba have seen notable declines in both access and use (Figure 3.3). This points to the likely role ITN distribution points have had in maintaining net use in Bioko Norte, as well as the need to consider a distribution strategy for Bioko Sur.

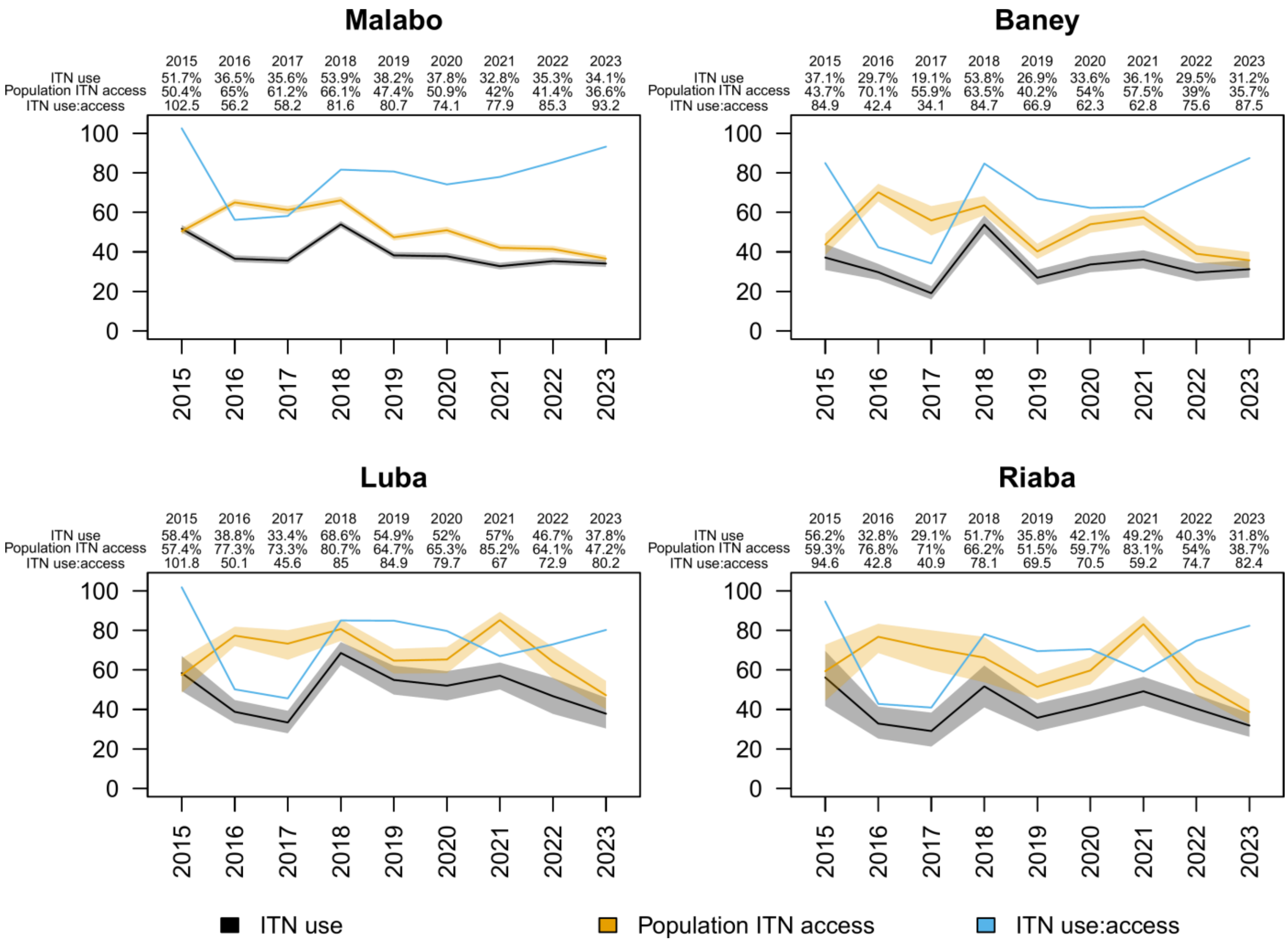


Figure 3.3: Historical trends in ITN population access, use, and use:access by district

Population access to ITNs, use of ITNs, and ratio between use and access (use:access) since 2015 by district. Note that population access to ITNs, ITN use and use:access are based on the *de jure* population here, since *de facto* household population has only been collected since 2019. The use:access ratio has been multiplied by 100 and can be interpreted similar to percentages, but values above 100 are possible, corresponding to more than two persons using an ITN on average.

3.2.5 Assessment of fixed-point ITN distribution

While island- or district-level trends can be informative about the impact of implementing fixed-point distributions, even districts hide much complexity. On the other hand, the BIMIS collects other information which, when merged with net indicators, can be more well-suited to assessing the net distribution strategy change. A straightforward analysis of how net use among households which have access to ITNs differs by whether the household had nets from a distribution point clearly shows that households which go to pick-up points are more likely to use nets (Figure 3.4). While unsurprising this result demonstrates that this strategy plausibly increases the efficiency of distributions (in terms of net use and resources required), as compared to a mass distribution campaign. However, it tells us nothing about the effectiveness at maintaining net use.

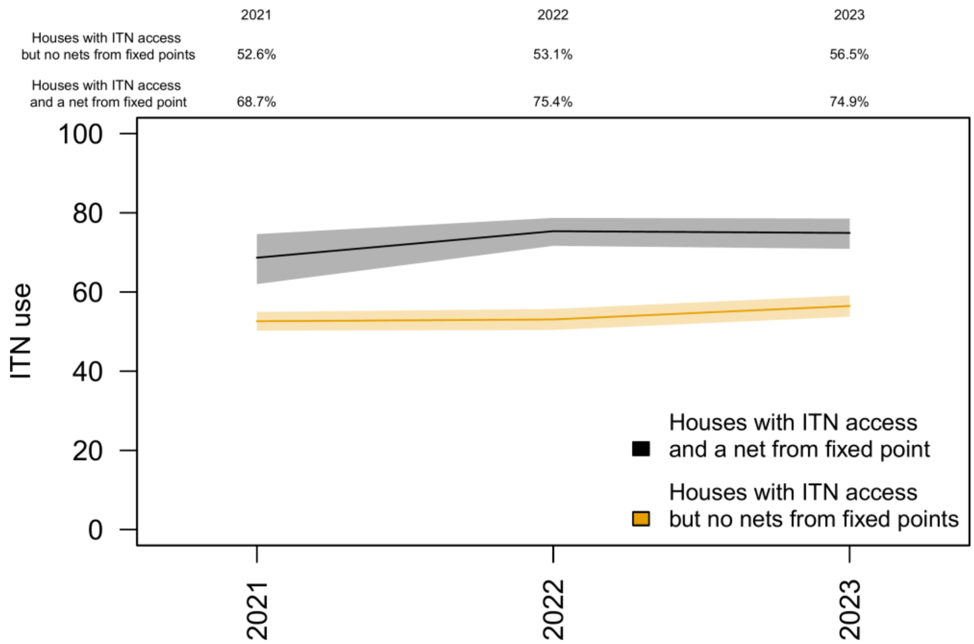


Figure 3.4: Use of ITNs by source of nets

Use of ITNs from 2021-2023 among households with access to ITNs, in those which had at least one net from a fixed distribution point and those with only nets from other sources.

The 2020 top-up campaign in high-transmission areas and subsequent implementation of fixed points in 2021 gives a useful set of comparisons which can inform more directly on the impacts of a community distribution and continuous fixed-point distribution. The trends in the areas of the urban stratum (in particular, 100m x 100m map sectors) where there was no top-up distribution give a sense of what the true impact of distribution points may have been, while those that received some top-up distribution show the impact of an urban distribution (Figure 3.5). The top-up distribution, as expected, increased use and access in Malabo, but had a much larger effect on access than use, and these effects were limited in time. On the other hand, the areas that did not receive top-up had a gradual decline of use and access until 2021, when distribution points were implemented and use began to stabilize and even increase, despite sustained declines in access. In summary then, the impact of the top-up in urban areas was limited, especially in terms of net use, while fixed distribution points were able to maintain and even increase use where no top-up was performed. This points to a greater efficiency of fixed-point distributions on Bioko (or at least in its urban areas).

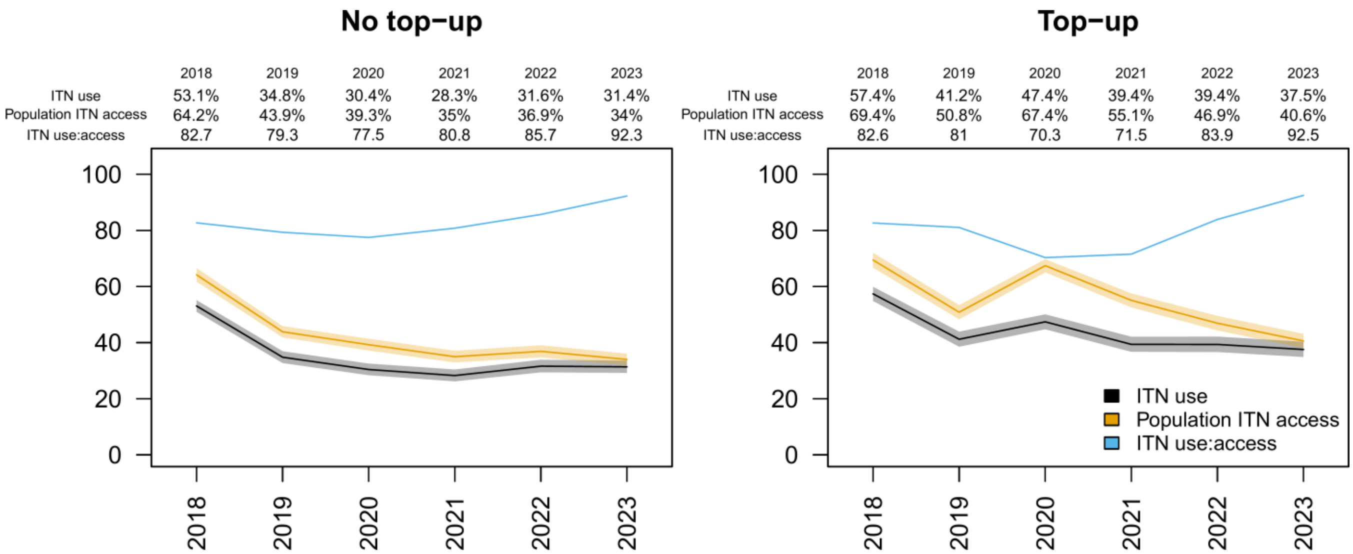


Figure 3.5: ITN Use, access and use:access in urban top-up and urban non top-up areas

Population access to ITNs, use of ITNs, and ratio between use and access (use:access) since 2018 in the urban stratum (so with possible access to ITN distribution points), in sectors which did not have any top-up campaign in 2020-2021 and in sectors which did receive some nets during a top-up campaign in 2020-2021

3.3 Reasons for not using bed nets

As discussed in sections above, ownership or even access to ITNs does not always correspond to use. Hence, for each existing mosquito net not used on the night preceding the survey, the 2023 BIMIS collected information on why the net was not used. This information is crucial to identify and potentially overcome barriers to use of mosquito nets. Saving the nets for later was by far the most common reason reported for not using nets (35.8%), although respondents in Baney district did not mention this as often (25.7%). Other notable reasons provided for not using nets were that they were not needed this season (10.1%), too hot (6.3%) or uncomfortable (7.0%), all of which were more commonly reported in Baney than other districts.

Table 3.7: Reasons for not using a net

Among nets which were not used, the percentage for which respondents indicated various reasons for not using.

	Number of unused nets	Reason for not using net (%)															
		Not effective	Too hot	Bad odor	Too uncomfort able	Irritate body	In bad condition	House sprayed	Not needed this season	None available	Have AC	Windows are screened	User did not sleep in house	Saving for later	Used by visitor	Other	Don't know
District																	
Malabo	1,202	0.2	5.7	1.0	6.9	1.9	3.9	0.0	7.6	1.7	1.7	0.0	15.1	37.2	1.6	15.4	4.3
Baney	248	0.0	9.3	0.0	8.5	6.5	5.6	0.3	22.4	0.9	0.9	0.0	7.1	25.7	1.9	15.5	2.3
Luba	245	0.0	6.2	0.0	5.5	2.0	1.6	0.8	11.8	1.6	4.7	0.0	10.6	42.5	0.3	16.0	0.5
Riaba	89	0.0	4.1	0.0	1.5	0.0	5.1	0.0	7.0	0.0	0.0	0.0	21.8	42.9	0.7	19.1	1.6
Age of household head																	
15-24	49	2.5	0.0	0.0	14.3	0.0	6.6	0.0	3.4	0.0	0.0	0.0	18.8	30.1	2.0	17.5	4.8
25-34	275	0.0	7.4	1.3	6.1	4.3	4.7	0.0	9.4	1.4	4.1	0.0	11.1	33.0	2.5	18.8	2.4
35-44	495	0.0	5.9	0.7	6.3	3.1	3.6	0.0	10.6	2.2	1.1	0.0	14.5	38.0	0.8	14.7	3.3
45-54	428	0.2	6.7	0.9	6.8	1.4	4.9	0.2	7.2	2.2	1.0	0.0	15.3	35.3	0.9	18.0	5.8
55+	537	0.0	6.2	0.3	7.8	2.3	3.3	0.2	14.1	0.6	1.5	0.0	12.5	36.3	2.3	11.5	3.2
Gender of household head																	
Male	1,118	0.1	6.0	0.8	6.7	2.0	4.3	0.2	10.3	2.0	1.8	0.0	13.9	36.1	0.5	16.4	3.6
Female	666	0.1	6.7	0.6	7.5	3.7	3.7	0.0	10.2	1.0	1.6	0.0	13.3	35.1	3.3	14.1	3.9
Education of household head																	
At most primary	217	0.6	7.8	0.0	9.0	6.6	5.5	0.0	10.0	1.2	2.7	0.0	10.3	36.4	2.8	15.8	1.9
Secondary	777	0.2	5.4	0.7	8.2	1.5	3.7	0.0	10.3	1.5	1.7	0.0	15.6	35.5	1.2	14.8	2.8
Post-secondary	426	0.0	8.3	0.7	5.5	3.1	2.9	0.2	9.6	1.2	2.2	0.0	12.4	36.1	1.9	16.9	4.3
Unknown	331	0.0	5.0	1.5	5.7	2.9	6.6	0.3	10.2	2.6	0.1	0.0	12.0	35.5	1.0	15.7	5.9
Wealth quintile																	
Lowest	342	1.0	7.8	0.0	8.4	5.1	5.4	0.4	11.3	2.0	0.0	0.0	15.2	36.7	0.2	12.1	1.0
Second	329	0.0	2.8	0.0	5.1	1.6	7.9	0.3	13.8	0.6	0.0	0.0	12.9	41.3	3.2	11.4	3.1
Middle	375	0.0	7.8	0.3	5.9	1.0	5.3	0.0	6.5	1.9	0.1	0.0	18.0	34.8	3.4	12.9	3.2
Fourth	380	0.0	5.6	0.8	6.6	2.2	1.7	0.0	13.2	1.1	0.9	0.0	11.6	35.0	0.3	22.0	3.7
Highest	358	0.0	7.2	1.9	9.0	4.0	2.0	0.0	8.0	2.2	6.1	0.0	11.4	33.0	0.6	16.1	6.0
Stratum																	
Rural/high transmission	680	0.0	5.8	0.0	4.6	1.9	4.2	0.9	13.8	2.8	3.8	0.0	14.5	33.1	1.0	15.8	1.6
Urban/low transmission	1,104	0.1	6.3	0.8	7.3	2.7	4.1	0.0	9.8	1.4	1.5	0.0	13.5	36.1	1.6	15.5	4.0
Total	**1,784**	**0.1**	**6.3**	**0.7**	**7.0**	**2.6**	**4.1**	**0.1**	**10.3**	**1.6**	**1.7**	**0.0**	**13.6**	**35.8**	**1.6**	**15.5**	**3.7**

3.4 Source and condition of bed nets

In addition to collecting information about the use of bed nets, surveyors collected information about the source, color, type and physical condition of bed nets, where possible by direct observation. As summarized in Table 3.8, most nets were reported as being received from a distribution campaign (21.1%), pick-up point (24.1%) or public health facility (30.9%). While efforts were made to avoid mis-coding responses, public health facility may be elevated due to conflation with distribution points, since points were located at public health facilities. The majority of nets in Luba and Riaba were sourced from a distribution campaign (71.1% and 61.8%, respectively), while in Malabo a many fewer were reported as coming from a distribution campaign (16.4%) than public health facility or pick-up point (29.8% and 28.1%, respectively).

Table 3.8: Source of nets in 2015

Proportion of nets which respondents indicated came from various sources.

	Total number of nets	Net Source (%)										
		Distribution campaign	School-based distribution	Government clinic/ hospital	Point of distribution	BIMEP office	Retail shop	Pharmacy	Workplace	Gift	Other	Don't know
District												
Malabo	4,136	16.4	0.2	29.8	28.1	2.0	10.3	0.0	0.2	7.3	2.5	3.1
Baney	659	31.9	0.0	41.7	8.7	1.1	5.7	0.0	0.0	8.4	1.0	1.5
Luba	444	71.7	0.0	12.9	4.4	0.0	1.4	0.0	0.0	5.9	1.3	2.3
Riaba	262	61.8	0.0	23.2	4.5	0.3	5.2	0.0	0.0	3.2	0.0	1.6
Age of household head												
15-24	119	15.4	0.0	27.2	26.6	1.1	6.8	0.0	0.0	17.8	1.9	3.1
25-34	856	14.2	0.4	34.3	21.5	0.6	10.3	0.2	0.0	11.6	2.4	4.4
35-44	1,702	19.7	0.1	29.2	24.7	2.9	12.5	0.0	0.1	5.1	2.8	2.7
45-54	1,361	20.4	0.2	30.5	27.3	1.2	7.4	0.0	0.6	8.2	2.2	2.0
55+	1,463	28.9	0.1	31.4	21.8	1.9	6.4	0.0	0.0	5.7	1.2	2.5
Gender of household head												
Male	3,546	20.6	0.2	31.1	22.6	2.4	9.8	0.1	0.2	7.6	2.6	2.9
Female	1,955	21.9	0.1	30.5	26.9	0.8	8.5	0.0	0.1	7.1	1.6	2.5
Education of household head												
At most primary	690	31.9	0.0	23.6	22.8	0.6	7.7	0.0	0.0	10.2	1.7	1.5
Secondary	2,266	21.6	0.2	32.8	25.6	1.2	8.1	0.1	0.3	6.4	1.8	1.9
Post-secondary	1,258	18.3	0.2	28.6	21.4	4.5	13.0	0.0	0.1	8.4	2.8	2.8
Unknown	1,183	19.9	0.1	31.0	26.2	0.3	7.9	0.0	0.1	7.2	2.8	4.5
Wealth quintile												
Lowest	1,017	30.5	0.0	24.7	20.6	1.0	8.4	0.0	0.0	8.9	2.6	3.3
Second	1,113	22.4	0.2	31.0	24.9	0.0	6.2	0.0	0.1	9.4	1.4	4.3
Middle	1,236	16.1	0.2	31.0	29.1	2.1	8.0	0.2	0.0	9.0	1.9	2.5
Fourth	1,214	21.7	0.1	33.3	24.6	1.8	7.3	0.0	0.3	6.1	2.5	2.4
Highest	921	18.3	0.4	31.9	19.2	4.0	17.3	0.0	0.3	4.1	2.9	1.7
Stratum												
Rural/high transmission	1,823	51.4	0.2	17.9	10.6	2.0	7.2	0.0	0.1	4.8	3.0	2.9
Urban/low transmission	3,678	18.0	0.2	32.2	25.5	1.8	9.5	0.0	0.2	7.7	2.1	2.8
Total	**5,501**	**21.1**	**0.2**	**30.9**	**24.1**	**1.8**	**9.3**	**0.0**	**0.2**	**7.4**	**2.2**	**2.8**

In line with a primarily different mode of sourcing, and current availability of nets in Malabo, nets in Malabo district tended to be in better condition than in other districts, with 70.1% having no holes. It was also much more common in Luba and Riaba to encounter nets which had never been used (10.5% and 14.9%, respectively) than in Malabo or Baney. Since there is little reason to believe a further distribution for households with this type of net would change use patterns, the efficiency and impact of a mass distribution in 2024 could be limited even outside Malabo.

Table 3.9: Condition of nets in 2015

Percentage of nets observed with no holes, only thumb-sized holes, at least one head-sized hole, and never used.

	Nets observed	Net condition (%)				
		No holes	Only thumb-sized holes	Head-sized hole	Never used	Don't know
District						
Malabo	2,307	70.1	14.2	7.8	7.7	0.1
Baney	336	61.7	19.2	10.8	7.9	0.5
Luba	201	63.7	15.5	10.3	10.5	0.0
Riaba	116	68.5	10.6	6.0	14.9	0.0
Age of household head						
15-24	70	67.0	13.1	9.5	7.6	2.8
25-34	488	67.5	14.4	8.1	9.7	0.3
35-44	911	70.0	15.5	8.2	6.3	0.0
45-54	751	70.3	14.2	7.7	7.7	0.1
55+	740	66.8	15.4	9.1	8.7	0.0
Gender of household head						
Male	1,921	67.4	14.4	8.8	9.3	0.1
Female	1,039	71.3	15.8	7.3	5.3	0.2
Education of household head						
At most primary	385	71.6	10.7	10.1	7.2	0.4
Secondary	1,243	66.6	16.9	8.3	8.1	0.1
Post-secondary	649	70.7	13.6	6.4	9.2	0.0
Unknown	636	69.5	14.8	9.4	6.0	0.3
Wealth quintile						
Lowest	539	70.1	14.5	10.5	4.9	0.0
Second	633	66.1	14.1	12.7	6.9	0.2
Middle	674	68.5	16.6	7.4	7.1	0.5
Fourth	645	67.7	18.0	6.6	7.6	0.0
Highest	469	72.7	9.4	5.2	12.6	0.1
Stratum						
Rural/high transmission	910	67.2	16.8	7.1	8.7	0.2
Urban/low transmission	2,050	68.9	14.7	8.4	7.8	0.2
Total	**2,960**	**68.8**	**14.9**	**8.3**	**7.9**	**0.2**

3.5 Vector control coverage

The overall coverage of vector control interventions is an important metric to assess the extent to which malaria programs are protecting the population, and if that protection is being provided equitably. In most cases, surveys are limited to estimating self-reported coverage by vector control interventions, since most malaria programs do not have operational data for vector control interventions (e.g., IRS) identified to the household level in a way that can be linked to survey data. A unique strength of BIMEP is the data infrastructure to use unique household identifiers in operational data collection. This also enables bringing together survey data with operational vector control data, for example to estimate the true coverage of IRS, rather than self-reported IRS coverage, in conjunction with ITN and other indicators. Table 3.10 reports the results of this analysis. More than two in three households (68.8%) owned at least one ITN or had received IRS in the 12 months preceding the survey. Coverage with IRS or access to ITNs for all household members was only slightly lower (59.8%). In all cases, vector control coverage was highest in Luba and Baney, somewhat lower in Baney and lowest in Malabo. This is driven in large part by the operational coverage targets set for IRS round 30, conducted in 2023. In particular, there were two map areas (1km x 1km) in central Malabo which were not included in the IRS plan, while all of the urban Malabo area had a coverage target of 50%, compared to 80% outside the urban area.

Table 3.10: Vector control coverage

Percentage of households in which the interior walls have been sprayed with insecticide (IRS) in the last 12 months, percentage of households with at least one ITN or that received IRS in the last 12 months, and percentage of households with at least one ITN for every two persons who stayed in the house the previous night (access to ITNs), by district of residence and wealth quintile.

	Household sprayed with IRS in last 12 months (%)	Household sprayed with IRS in last 12 months or own ITN (%)	Household sprayed with IRS in last 12 months or access to ITNs (%)
District			
Malabo	41.7	66.8	57.4
Baney	56.7	73.4	65.6
Luba	81.0	89.9	85.9
Riaba	83.8	92.5	91.8
Age of household head			
15-24	50.5	65.6	61.2
25-34	44.5	61.3	55.3
35-44	43.0	67.8	57.2
45-54	47.7	74.6	62.5
55+	48.3	77.4	68.9
Gender of household head			
Male	46.6	68.4	59.7
Female	43.2	69.5	60.0
Education of household head			
At most primary	54.9	79.1	72.2
Secondary	46.0	69.7	61.7
Post-secondary	41.5	61.9	53.5
Unknown	46.0	73.2	59.5
Wealth quintile			
Lowest	52.2	69.8	65.3
Second	46.3	70.5	62.0
Middle	45.2	72.6	62.1
Fourth	45.3	70.6	59.5
Highest	38.6	60.2	50.3
Stratum			
Rural/high transmission	72.4	82.6	79.8
Urban/low transmission	42.8	67.4	57.8
Total	**45.5**	**68.8**	**59.8**

3.6 Malaria prevention in pregnancy

Antenatal care (ANC) coverage

Percentage of women who attended at least one ANC visit in their last completed pregnancy

Denominator: Women 15-49 years old who had a live birth in the two years preceding the survey

ANC bed net coverage

Percentage of women who received a bed net at an ANC visit during their last pregnancy

Denominator: Women 15-49 years old who had a live birth in the two years preceding the survey and attended at least one ANC visit during their last pregnancy

Intermittent preventative treatment during pregnancy (IPTp-SP)

Percentage of women who took three or more doses of Sulphadoxine/Pyrimethamine (SP) during their last pregnancy

Denominator: Women 15-49 years old who had a live birth in the two years preceding the survey and attended at least one ANC visit during their last pregnancy

Pregnant women are at significantly higher risk for malaria complications than non-pregnant adult women, and malaria infection can impact the health of the mother and fetus during pregnancy. The World Health Organization (WHO) recommends a three approaches package to reduce the effect of malaria in pregnancy. This package includes prompt diagnosis and effective treatment of malaria infections, the use of ITNs, and IPTp-SP as part of ANC services.[29] IPTp-SP is a highly cost-effective approach in reducing maternal morbidity and low birth weight.[30] The WHO recommends administering three or more doses of IPTp-SP to pregnant women living in moderate-to-high malaria transmission areas in Africa, starting as early as possible in the second trimester and continuing at monthly intervals up to delivery time.[29] All of these approaches have been adopted on Bioko Island, and this section summarizes coverage of the different aspects of malaria prevention in pregnancy based on the BIMIS.

3.6.1 Antenatal care coverage

Women attending ANC clinics get access to a complete package of interventions to improve the outcome of their pregnancy. ANC services should ideally be delivered by skilled health providers capable of assessing the pregnancy status, delivering the package of interventions, and providing additional clinical management when necessary. Women aged 15 to 49 who had a live birth within the past two years preceding the survey were directly interviewed on ANC attendance and IPTp-SP during that pregnancy.

Nearly all (95.1%) women with a live birth in the last two years reported receiving ANC care of some kind (Table 3.11). Among those who received ANC, more than half (55.9%) received that care in a hospital, and four of every five (80.6%) in a public facility. Use of private facilities for ANC was most common in Malabo (18.8%) and Baney (17.3%) districts, and among the highest wealth quintile (36.0%). ANC coverage varied little by age but was slightly lower for women in the lowest wealth quintile (92.8%).

Table 3.11: Coverage of antenatal care for pregnant women

Number and percentage of women who gave birth in the two years preceding the survey who reported attending one or more ANC visit during their last pregnancy, and among those who attended ANC the percentage who received care at specific types of facilities, by age, education level, district of residence, wealth quintile, and stratum.

	Women with live birth in last two years	Received ANC (%)	Women receiving ANC	Public		Any public facility	Private				Any private facility	Other
				Hospital	Health center		Private clinic	Laboratory	Chinese consultation room	Traditional practitioner		
Age												
15-24	337	95.2	317	61.9	26.2	88.1	10.8	0.1	0.0	0.0	10.9	0.9
25-34	536	95.4	510	53.5	22.3	75.8	22.5	0.0	0.0	0.3	22.8	1.4
35-44	184	94.8	176	51.2	29.9	81.1	17.4	0.0	0.0	0.0	17.4	1.5
45-54	5	79.8	4	74.8	0.0	74.8	25.2	0.0	0.0	0.0	25.2	0.0
Education level												
At most primary	82	94.6	75	47.6	36.4	83.9	14.2	0.0	0.0	0.0	14.2	1.9
Secondary	381	95.4	363	58.1	25.6	83.7	14.7	0.0	0.0	0.4	15.1	1.2
Post-secondary	290	96.6	282	52.6	20.9	73.5	25.8	0.1	0.0	0.0	25.9	0.5
Unknown	283	93.3	263	57.2	25.8	83.0	14.8	0.0	0.0	0.0	14.8	2.2
District												
Malabo	848	94.6	798	55.7	24.5	80.2	18.6	0.0	0.0	0.2	18.8	1.0
Baney	115	97.8	112	52.7	26.9	79.6	17.3	0.0	0.0	0.0	17.3	3.1
Luba	49	100.0	49	70.0	25.6	95.7	2.9	0.0	0.0	0.0	2.9	1.4
Riaba	50	96.1	48	81.0	14.7	95.7	4.3	0.0	0.0	0.0	4.3	0.0
Wealth Quintile												
Lowest	154	92.8	142	63.9	29.1	93.1	5.6	0.0	0.0	1.1	6.7	0.2
Second	239	96.2	225	59.9	28.2	88.1	10.6	0.1	0.0	0.0	10.7	1.1
Middle	239	94.0	227	56.9	25.9	82.8	16.0	0.0	0.0	0.0	16.0	1.1
Fourth	222	95.0	211	57.7	25.0	82.6	17.2	0.0	0.0	0.0	17.2	0.1
Highest	208	96.8	202	43.8	16.9	60.8	36.0	0.0	0.0	0.0	36.0	3.3
Stratum												
Rural/high transmission	326	93.9	306	58.8	26.2	85.0	13.6	0.4	0.0	0.0	14.0	1.0
Urban/low transmission	736	95.2	701	55.6	24.6	80.2	18.4	0.0	0.0	0.1	18.5	1.3
Total	**1,062**	**95.1**	**1,007**	**55.9**	**24.7**	**80.6**	**18.0**	**0.0**	**0.0**	**0.1**	**18.2**	**1.3**

3.6.2 ANC services provided

In collaboration with the NMCP, BIMEP distributes ITNs and provides IPTp-SP free of charge to pregnant women receiving ANC care in public facilities. Table 3.12 summarizes the proportion of women with a live birth in the last two years who attended ANC that received an ITN or IPTp-SP during ANC. Overall, around two-thirds (65.9%) received an ITN, though this was (unsurprisingly) much higher in public facilities (75.2%) than private (27.5%). Public and private facilities provided IPTp at similar rates, with 40.5% overall receiving three doses or more, as recommended by the WHO and stipulated in the National Malaria Control Strategy. The coverage of three doses of IPTp was higher in the urban stratum, but also lower in Malabo compared to other districts.

Table 3.12: Coverage of antenatal services

Among women with a live birth in the two years preceding the survey who attended at least one ANC visit, the proportion who reported receiving a bed net, and among those who could recall the number of ITPp-SP doses received in their last pregnancy, the proportion that received at least one, two or three doses of IPTp-SP by age, education level, district of residence, wealth quintile, stratum, and ANC facility type.

	Received bed net (%)	Number of women with one or more ANC	Number of IPTp-SP doses received (%)			Number of women with known number of IPTp doses
			One or more	Two or more	Three or more	
Age						
15-24	71.5	314	85.3	55.8	32.2	226
25-34	62.5	503	85.9	63.9	45.1	379
35-44	66.0	172	90.0	61.9	40.5	131
45-54	49.7	4	49.7	49.7	49.7	4
Education level						
At most primary	65.0	73	90.2	52.4	23.9	52
Secondary	65.5	361	89.2	65.2	43.0	267
Post-secondary	60.5	275	81.3	60.2	42.8	213
Unknown	73.0	260	87.9	58.0	38.6	189
District						
Malabo	66.4	787	85.5	60.1	39.1	579
Baney	60.2	110	88.5	66.8	47.7	86
Luba	69.9	49	94.5	62.6	50.0	36
Riaba	85.6	47	89.6	58.3	42.3	39
Wealth Quintile						
Lowest	75.2	140	88.4	59.6	41.7	97
Second	68.7	223	85.4	61.3	40.9	160
Middle	70.9	226	88.6	59.6	37.2	167
Fourth	71.1	206	89.2	64.1	42.0	166
Highest	46.5	198	79.6	59.7	41.5	150
Stratum						
Rural/high transmission	68.1	303	85.9	57.0	33.3	232
Urban/low transmission	65.7	690	86.2	61.4	41.2	508
ANC facility type						
Private	27.5	167	74.3	55.7	39.2	117
Public	75.2	814	89.3	62.7	41.2	618
Total	**65.9**	**993**	**86.2**	**61.0**	**40.5**	**740**

3.6.3 Use of ITNs

While measuring the coverage of ANC and related services requires considering previously completed pregnancies, it is possible to directly observe the use of mosquito nets by currently pregnant women. However, this indicator may change more quickly in response to changes in malaria control activities than ANC-related indicators, since ANC-related indicators are calculated based on a moving two-year window. Table 3.13 summarizes use of mosquito nets among women pregnant at the time of the survey. Use of ITNs among pregnant women was the same as in the general population (33.7%), but was lower in the rural stratum and Bioko Sur, and decreased with level of education.

Table 3.13: Use of bed nets among currently pregnant women

Percentage of pregnant women who slept under a bed net (treated or untreated) or an insecticide-treated net (ITN) the night before being surveyed in all households, households with at least one ITN, and households with full access to ITNs (i.e., at least one ITN per two *de facto* members), by age, education level, district of residence, household wealth and stratum.

	All households			Households with at least one ITN			Households with full access to ITNs		
	any net (%)	ITN (%)	# individuals	any net (%)	ITN (%)	# individuals	any net (%)	ITN (%)	# individuals
Age									
15-24	40.0	36.8	101	66.9	64.0	55	84.5	84.5	29
25-34	34.9	30.3	141	64.6	60.9	68	79.3	79.3	31
35-44	43.5	37.5	42	84.8	78.5	19	96.8	96.8	7
45-54	100.0	100.0	1	100.0	100.0	1			
Education level									
At most primary	43.4	30.8	19	85.8	85.8	10	100.0	100.0	7
Secondary	41.6	38.1	110	75.4	69.0	59	87.2	87.2	31
Post-secondary	30.2	26.0	91	55.3	55.3	39	83.6	83.6	14
Unknown	43.0	42.0	57	76.5	75.7	30	95.3	95.3	11
District									
Malabo	40.4	34.8	212	68.8	64.2	109	84.0	84.0	46
Baney	30.8	30.8	46	70.0	70.0	21	82.1	82.1	15
Luba	20.6	20.6	12	35.1	35.1	8	100.0	100.0	2
Riaba	25.9	25.9	15	78.7	78.7	5	73.3	73.3	4
Wealth Quintile									
Lowest	34.8	33.1	40	71.5	69.8	19	86.1	86.1	11
Second	55.7	51.1	55	87.4	87.4	30	93.6	93.6	18
Middle	35.2	31.1	68	57.8	54.1	38	74.4	74.4	15
Fourth	41.8	36.0	64	75.3	67.9	33	84.7	84.7	14
Highest	23.0	18.9	58	49.0	44.2	23	75.0	75.0	9
Stratum									
Rural/high transmission	30.3	27.9	86	66.0	63.4	38	83.3	83.3	18
Urban/low transmission	38.7	34.2	199	68.5	64.7	105	83.5	83.5	49
Total	**38.0**	**33.7**	**285**	**68.4**	**64.6**	**143**	**83.5**	**83.5**	**67**

3.6.4 Trends of malaria prevention in pregnancy over time

Coverage of different aspects of malaria prevention in pregnancy have remained stable since 2015 (Figure 3.6). Consistently, more than 90% of women with a live birth in the two years preceding the survey received some ANC, while the proportion of those who received an ITN from their ANC has modestly increased. ITN use broadly follows historical patterns of ITN use in the general population. In 2022, there was a decrease in ITN use, maintained in 2023, but this has not translated into sustained increases in malaria prevalence among pregnant women (see Chapter 5).

	2015	2016	2017	2018	2019	2020	2021	2022	2023
ITN use	56.7%	37.5%	31.6%	57.4%	36.4%	45.6%	44.8%	35.3%	32.3%
ANC Coverage	96.3%	97.1%	97.8%	97.2%	97.5%	98.6%	97.6%	95.8%	94.8%
ANC Bednet Coverage	60.9%	53.5%	59.6%	63.8%	66.1%	66.1%	67.2%	68.9%	66.5%
IPTp3 Coverage	52.6%	45.9%	49.7%	47.2%	47.6%	49.4%	41.9%	45.2%	38.8%

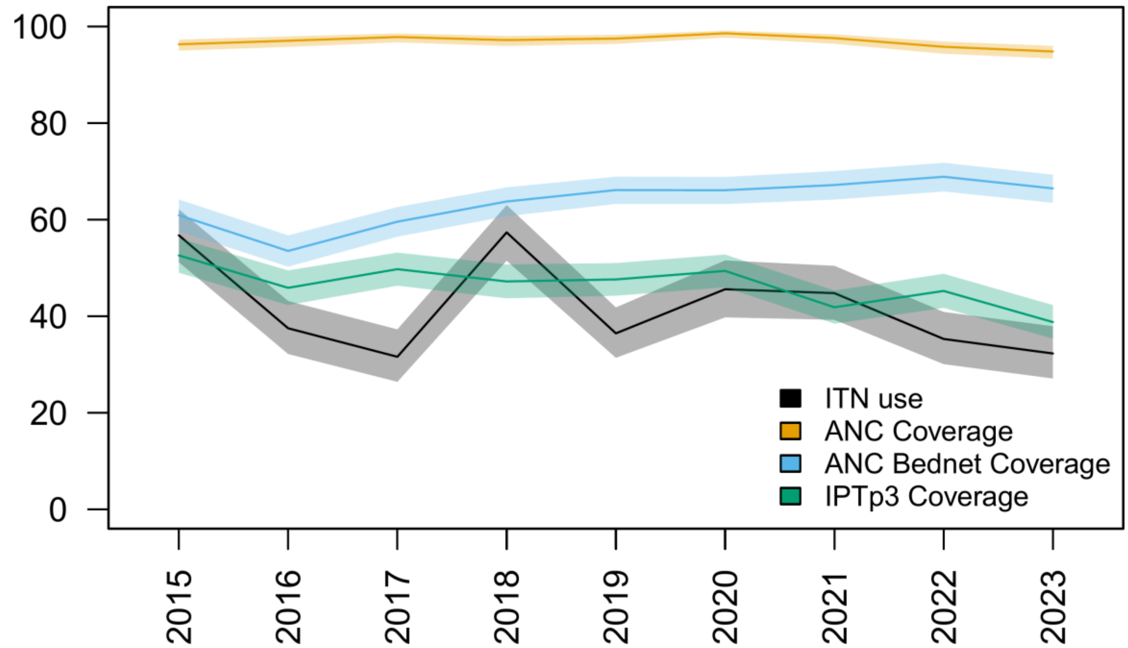


Figure 3.6: Historical coverage of malaria prevention in pregnancy

Percentage of pregnant women who slept under an ITN the night preceding the survey, percentage of women with a live birth in the last two years who received any ANC care, and percentage of those who attended ANC that received a bed net, and three or more doses of IPTp, from 2015-2022.

4 MANAGEMENT OF FEVER

Key Findings

- **Fever prevalence:** 8.1% of all individuals, including 8.7% of children under age five reported having a fever in the two weeks preceding the survey
- **Care seeking:** Advice or treatment was sought for 62.8% of individuals with fever in the two weeks preceding the survey, including 75.4% of children under age five
- **Testing:** A blood sample was taken for testing from 64.6% of children under age five with a fever in the two weeks preceding the survey, including 90.9% of those for whom treatment was sought in public facilities
- **Antimalarial treatment:** 66.3% of febrile children under age five testing positive for malaria received an antimalarial, but only 48.7% of those who received treatment in a public facility
- **Type of antimalarial received:** Among children under age five with recent history of fever who received an antimalarial, approximately two in five (42.8%) received an artemisinin-based combination therapy (ACT)

The NMCP and BIMEP promote malaria case management through prompt diagnosis and treatment using appropriate and effective medicines to reduce malaria-associated morbidity and mortality on Bioko Island. The national malaria treatment guidelines of Equatorial Guinea recommend that all suspected malaria cases be confirmed either by microscopy or RDT and treated with adequate antimalarial drugs. The 2019 revised guidelines recommend Artemether/Lumefantrine (AL) as the first-line treatment for uncomplicated malaria.[31]

This chapter presents indicators related to management of fever in the general population and (in more detail) among children less than five years old. The findings can help design advocacy, communication, and social mobilization programs to support effective case management of fever and malaria. Importantly, the BIMIS is also currently the only source of information about adherence to national guidelines in private health facilities, and as such is crucial in designing a case management supervision and action plan to improve the quality of services provided beyond public health facilities.

4.1 Fever prevalence and treatment seeking

Fever prevalence

Percentage of individuals who reported having had a fever in the two weeks preceding the survey

Denominator: *De jure* household population

Care seeking

Percentage of individuals with a fever in the two weeks preceding the survey for whom advice or treatment was sought from a health provider, health facility, or pharmacy

Denominator: *De jure* household members who had a fever in the two weeks preceding the survey

Fever is a key symptom of malaria and other acute infections, particularly among children. Malaria-related fevers require prompt and effective treatment to prevent malaria morbidity and mortality. Table 4.1 describes the prevalence of fever and related treatment seeking behavior observed in the BIMIS. In total 8.1% of individuals registered reported having fever in the two weeks preceding the survey. Treatment of some kind was sought for around two thirds (62.8%) of those with recent fever, including almost four in five (75.4%) children under five years old. Treatment seeking increased with household wealth, education of the household head, and was higher in urban areas than rural areas. This is likely driven by increased ability to seek care at private facilities, which comprised a larger share of treatment seeking in these groups. Overall, public facilities accounted for only 38.8% of all treatment seeking for fever, but the vast majority of treatment seeking in Luba and Riaba was in public facilities (80.2% and 76.2%, respectively). This continues a trend seen since at least 2015 of increasing use of private facilities for fever treatment (Figure 4.1).

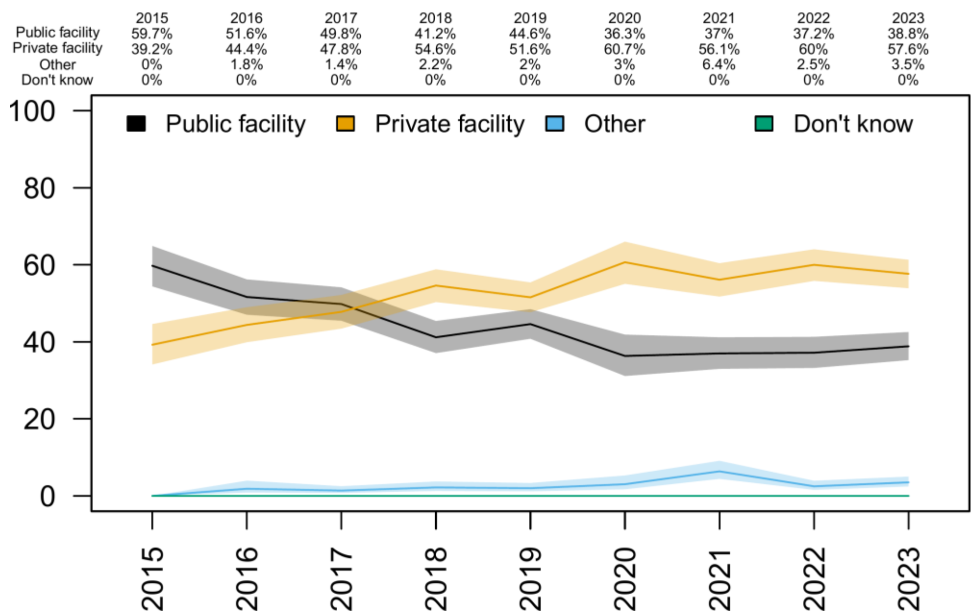


Figure 4.1: Historical trends in use of public and private facilities for fever treatment seeking

Percent of individuals (all ages) reporting seeking treatment for fever in the two weeks preceding the survey who reported going to facilities of different types (public, private and other), for fever treatment since 2015.

Table 4.1: Treatment seeking for fever

Number of individuals with fever in the two weeks preceding the survey, the percentage of these for whom treatment was sought, and among those who sought treatment the percentage who sought treatment in specific types of facilities.

	Fever prevalence	Number of febrile individuals	Sought treatment (%)	Sought treatment (#)	Public		All public facilities	Private						All private facilities	Other	Don't know
					Hospital	Health center		Private Clinic	Pharmacy	Retail store	Laboratory	Family practitioner	Traditional healer			
Age																
<5	8.7	223	75.4	159	37.0	7.1	44.1	24.5	29.2	0.0	0.0	0.0	0.0	53.7	2.2	0.0
5-14	5.9	296	63.3	182	31.3	11.3	42.5	16.6	39.4	0.0	0.1	0.0	0.0	56.2	1.3	0.0
15-24	7.9	292	57.1	159	32.2	5.6	37.8	19.4	40.0	0.0	0.8	0.0	0.0	60.2	2.0	0.0
25-34	9.4	288	62.1	171	27.1	5.8	32.9	25.0	38.8	0.0	0.0	0.0	0.0	63.9	3.2	0.0
35-44	9.4	247	55.7	131	26.8	4.3	31.1	31.7	34.1	0.0	0.0	0.0	0.0	65.7	3.1	0.0
45-54	9.7	129	68.6	86	31.3	8.3	39.6	18.1	30.0	0.0	0.0	0.0	0.3	48.4	11.9	0.0
55+	7.6	109	61.9	61	38.2	13.4	51.5	23.4	16.9	0.0	0.0	0.0	0.0	40.4	8.1	0.0
Gender																
Female	8.6	858	60.4	507	32.5	7.5	40.0	23.5	33.6	0.0	0.3	0.0	0.1	57.4	2.6	0.0
Male	7.5	726	65.5	442	30.2	7.4	37.5	21.6	36.3	0.0	0.1	0.0	0.0	58.0	4.5	0.0
District																
Malabo	7.8	1,204	64.0	746	29.7	7.4	37.1	24.0	35.6	0.0	0.2	0.0	0.0	59.9	3.0	0.0
Baney	9.1	233	58.3	128	32.0	7.6	39.6	19.4	36.0	0.0	0.0	0.0	0.0	55.4	5.0	0.0
Luba	8.8	77	62.4	47	73.3	6.9	80.2	2.3	12.0	0.0	0.0	0.0	0.0	14.3	5.5	0.0
Riaba	8.5	70	39.2	28	68.7	7.6	76.2	0.0	6.8	0.0	0.0	0.0	0.0	6.8	16.9	0.0
Education of household head																
At most primary	8.2	144	46.8	58	23.9	6.7	30.6	41.2	26.7	0.0	0.5	0.0	0.0	68.4	1.0	0.0
Secondary	8.7	643	60.7	371	28.5	8.8	37.3	19.0	40.4	0.0	0.3	0.0	0.1	59.8	2.9	0.0
Post-secondary	6.8	374	69.9	264	34.5	4.7	39.2	34.1	22.8	0.0	0.0	0.0	0.0	56.9	3.9	0.0
Unknown	9.0	407	64.0	250	33.6	8.9	42.5	11.5	41.3	0.0	0.0	0.0	0.0	52.8	4.7	0.0
Wealth quintile																
Lowest	10.7	287	49.6	127	28.1	6.7	34.8	15.6	44.0	0.0	0.0	0.0	0.0	59.5	5.7	0.0
Second	9.3	319	57.3	176	23.9	4.5	28.3	21.8	47.6	0.0	0.7	0.0	0.0	70.1	1.6	0.0
Middle	8.5	339	63.5	209	32.2	12.1	44.3	17.5	34.2	0.0	0.0	0.0	0.0	51.8	3.9	0.0
Fourth	7.2	321	67.7	206	31.6	7.5	39.1	22.6	36.5	0.0	0.0	0.0	0.1	59.2	1.7	0.0
Highest	6.4	318	72.9	231	38.1	5.9	44.1	31.6	19.1	0.0	0.1	0.0	0.0	50.8	5.2	0.0
Stratum																
Rural/high transmission	8.8	529	52.2	276	39.2	12.0	51.3	18.8	23.3	0.0	0.4	0.0	0.4	42.8	6.0	0.0
Urban/low transmission	8.0	1,055	63.8	673	30.7	7.1	37.8	22.9	35.9	0.0	0.1	0.0	0.0	58.9	3.3	0.0
Total	**8.1**	**1,584**	**62.8**	**949**	**31.4**	**7.4**	**38.8**	**22.6**	**34.9**	**0.0**	**0.2**	**0.0**	**0.0**	**57.7**	**3.5**	**0.0**

4.2 Fever diagnosis and treatment for children

Fever diagnosis in febrile children under 5 years old

Percentage of febrile children under age five who had blood taken from a finger or heel for testing (this is a proxy measure of diagnostic testing for malaria)

Denominator: Children under age five with a fever in the two weeks preceding the survey for whom advice or treatment was sought

Antimalaria treatment for children under age five

Percentage of febrile children under age five testing positive for malaria who received an antimalarial treatment of any kind

Denominator: Children under age five with a fever in the two weeks preceding the survey who tested positive for malaria while seeking treatment

Artemisinin-based combination therapy for children under age five

Percentage of children under age five with recent fever and that received an antimalaria treatment of any kind who received an artemisinin-based combination therapy (ACT)

Denominator: Children under age five with a fever in the two weeks preceding the survey who received any antimalarial drugs as treatment for fever

Among children under five years with a recent fever who also were taken to a facility for treatment, the MIS collects additional indicators about the type of care that facility provided. These data give some insight into the adherence of facilities to national guidelines, but it is important to remember that they are reported by the patient, up to two weeks after care was provided. As such, recall bias may alter the absolute levels of adherence in these estimates, but is less likely to alter trends between groups significantly.

With these caveats, Table 4.2 summarizes reported diagnosis and treatment of malaria among febrile children under five. Two thirds (64.6%) of febrile children seeking care were tested for malaria, and most who tested positive received an antimalarial (66.3%). Testing febrile children for malaria was much more common in public health facilities (90.9%) than private facilities (44.0%), and treatment of children without positive malaria test results was more common in private facilities. Unfortunately, the number of children in households surveyed reporting a positive malaria test in the last two weeks was too low for a meaningful comparison of adherence to treatment guidelines in public and private facilities. These results suggest a general trend towards better adherence to national treatment guidelines in public health facilities than private facilities, which would not be surprising given then substantial effort of the NMCP and BIMEP to improve the quality of care for malaria in public facilities. Nevertheless, apparently lower adherence in private facilities is concerning given the overall high level of use of private facilities.

Table 4.2: Fever diagnosis and treatment for children under 5

Number of children under 5 years old with fever in the two weeks preceding the survey for whom treatment was sought, percentage of these for whom a blood sample was taken for diagnosis, and the number of children who tested positive for malaria or who did not have a positive malaria test (i.e., either no test was taken or the result was negative) and percentage that received any antimalarial

	Children taken to facility		Tested positive for malaria		No positive malaria test	
	Number of children	Blood sample taken (%)	Number of children	Given antimalarial (%)	Number of children	Given antimalarial (%)
District						
Malabo	114	65.1	16	70.2	56	14.8
Baney	26	63.6	2	16.0	14	8.5
Luba	7	43.1	2	51.8	4	0.0
Riaba	4	76.1	2	100.0	0	
Gender						
Female	64	62.4	13	84.8	31	16.2
Male	87	66.1	9	46.2	43	11.6
Age (months)						
<12	30	71.0	5	33.7	17	1.5
12-23	33	70.6	7	100.0	13	26.1
24-35	34	68.9	2	15.0	18	12.1
36-47	23	50.6	3	53.8	12	9.9
48-59	31	57.6	5	70.9	14	20.2
Education of household head						
At most primary	10	68.4	1	100.0	5	0.0
Secondary	51	59.9	6	66.6	27	22.6
Post-secondary	48	81.7	11	60.9	17	6.6
Unknown	39	51.6	4	74.9	23	12.7
Treatment facility type						
Private	75	44.0	8	85.8	43	19.2
Public	71	90.9	13	48.7	29	4.4
Total	**151**	**64.6**	**22**	**66.3**	**74**	**13.4**

To ensure effective treatment, the WHO recommends that all confirmed uncomplicated *P. falciparum* malaria cases be treated with an artemisinin-based combination therapy (ACT). Despite this recommendation, and despite the national guidelines of Equatorial Guinea specifying Artemether-Lumefantrine (AL), an ACT, as the first-line treatment for uncomplicated malaria, only two of five children (42.8%) receiving an antimalarial reported receiving an ACT. A similar proportion reported receiving Artemether, indicating likely deviation from treatment protocols by health practitioners. This overuse of artemisinin monotherapy is concerning, as it contributes to drug resistance pressure, and eventually may result in a decrease in the effectiveness of ACTs.[32]

Table 4.3: Type of antimalaria used to treat febrile children under 5

Among children under 5 who had a fever in the two weeks preceding the survey and received an antimalarial treatment of any kind, the percentage who received specific antimalarial treatments, by age, gender, district of residence, education level of the household head, wealth quintile, stratum and the type of facility where treatment was received.

	Number of febrile children that took any antimalarial	Type of antimalarial taken (%)						
		Any ACT	Artesunate	Amodiaquine	Chloroquine	Fansidar	Quinine	Artemether
District								
Malabo	27	43.2	19.3	0.0	0.0	0.0	10.2	32.2
Baney	2	15.9	0.0	0.0	0.0	0.0	0.0	84.1
Luba	2	51.3	0.0	0.0	0.0	0.0	0.0	0.0
Riaba	2	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Age in months								
<12	3	100.0	0.0	0.0	0.0	0.0	0.0	0.0
12-23	11	37.2	16.2	0.0	0.0	0.0	0.0	58.1
24-35	7	30.0	21.9	0.0	0.0	0.0	22.0	26.1
36-47	5	53.1	39.2	0.0	0.0	0.0	0.0	0.0
48-59	7	43.8	8.7	0.0	0.0	0.0	21.5	26.0
Gender								
Female	20	44.8	12.6	0.0	0.0	0.0	15.9	32.8
Male	13	40.0	24.6	0.0	0.0	0.0	0.0	35.4
Education of household head								
At most primary	3	27.8	72.2	0.0	0.0	0.0	0.0	0.0
Secondary	11	43.6	2.6	0.0	0.0	0.0	12.8	38.4
Post-secondary	12	32.4	36.7	0.0	0.0	0.0	14.2	30.6
Unknown	7	59.4	0.0	0.0	0.0	0.0	0.0	40.6
Wealth quintile								
Lowest	3	55.2	0.0	0.0	0.0	0.0	0.0	44.8
Second	11	39.5	0.0	0.0	0.0	0.0	11.7	48.8
Middle	4	68.9	0.0	0.0	0.0	0.0	31.1	0.0
Fourth	7	30.9	37.2	0.0	0.0	0.0	0.0	26.6
Highest	8	33.3	61.5	0.0	0.0	0.0	0.0	30.2
Stratum								
Rural/high transmission	14	48.8	29.3	0.0	0.0	0.0	0.0	14.6
Urban/low transmission	19	41.9	15.9	0.0	0.0	0.0	10.6	36.7
Treatment facility type								
Private	18	40.7	12.8	0.0	0.0	0.0	13.0	39.9
Public	13	48.3	31.4	0.0	0.0	0.0	0.0	20.2
Total	**33**	**42.8**	**17.6**	**0.0**	**0.0**	**0.0**	**9.3**	**33.9**

4.3 Use of antimalarials in the general population

To complement the specific information collected for recent fevers presented above, the BIMIS also included questions on the use of antimalarial drugs in the general population in the two months preceding the survey (Table 4.4). The vast majority of the population (92.8%) reported no use of any antimalarial in the eight weeks preceding the survey. This varied little by district, education, age or gender. Among those who did report using an antimalarial in the last eight weeks, nearly all reported using only one and most (83.3%) reported completing the treatment regimen. As above, interpretation of these estimates should take into account likely response bias, which is likely to be more considerable for the longer time period under consideration (8 weeks). Respondents may also be less likely to recall use of antimalarial medication by older household members than children if the illness prompting treatment was not as severe or concerning. Finally, a complementary activity in the 2023 BIMIS followed-up some individuals who tested positive during the survey to assess adherence, and while the results were not representative due to selection of high-risk individuals for follow-up (and hence not presented in this report), they do suggest that true adherence to antimalarial treatments on Bioko could be substantially lower than these self-reported estimates.

Table 4.4: Use of antimalarials in the population

Use of antimalarials in the 8 weeks preceding the survey and percentage of those who reported taking an antimalarial that completed the treatment regimen, by gender, age, district of residence, household head education level, wealth quintile and stratum

	Number of antimalarials taken (%)				Individuals taking antimalarial(s)	Completed regimen
	None	One	Two	Three or more		
Gender						
Female	92.3	6.7	0.7	0.3	772	84.0
Male	93.3	5.9	0.6	0.2	625	82.4
Age						
<5	94.2	5.2	0.3	0.3	156	88.0
5-14	94.5	5.0	0.4	0.1	276	86.1
15-24	93.1	6.0	0.7	0.2	255	78.3
25-34	91.3	7.7	0.7	0.3	257	77.6
35-44	92.2	6.3	1.1	0.5	202	84.9
45-54	89.2	9.6	0.9	0.4	131	92.5
55+	91.3	7.4	0.9	0.3	120	81.2
District						
Malabo	92.6	6.4	0.7	0.3	1,133	84.3
Baney	94.3	5.3	0.1	0.2	137	74.6
Luba	90.3	8.5	0.9	0.4	75	87.4
Riaba	93.8	5.3	0.7	0.1	52	90.1
Education of household head						
At most primary	93.9	5.5	0.4	0.2	95	93.3
Secondary	92.5	6.5	0.7	0.3	543	82.9
Post-secondary	92.8	6.3	0.7	0.2	425	83.4
Unknown	93.0	6.1	0.7	0.2	320	81.1
Stratum						
Rural/high transmission	92.6	6.7	0.5	0.2	448	88.1
Urban/low transmission	92.9	6.2	0.6	0.3	949	82.8
Total	**92.8**	**6.3**	**0.6**	**0.3**	**1,397**	**83.3**

5 MALARIA AND ANEMIA PREVALENCE

Key Findings

- **General malaria prevalence**: Malaria prevalence was 12.9%, 7.7%, and 10.9% in the general population, children < 5 years old, and pregnant women, respectively
- **Spatial heterogeneity**: Malaria prevalence on Bioko Island is highly heterogeneous, with hot spots on the west and southeast coasts
- **Change in malaria prevalence**: The percentage of individuals testing positive for malaria by RDT decreased by nearly two percent from 2022 (14.6%) to 2023 (12.9%)

One of the primary objectives of the BIMIS is to assess malaria prevalence, in order to evaluate the impact of various activities on malaria transmission. Malaria was tested using RDTs, and results were communicated to survey participants on-site. All individuals with positive RDTs were offered free treatment, according to the Equatorial Guinea national malaria treatment guidelines. All individuals between six months and 14 years old and pregnant women were also tested for anemia. Results for anemia were communicated to participants on site and directed to a health facility for treatment where necessary. This chapter presents results of both malaria and anemia testing. Note that all estimates presented here are weighted based on the sampling design (see Chapter 1 for explanation) so somewhat differ from those presented pre-2022 BIMIS reports. Section 5.3 provides internally consistent comparisons of historical prevalence based on this method of weighting. In addition, Appendix D reports crude malaria and anemia prevalence.

5.1 Malaria prevalence in the general population

Malaria Prevalence

Percentage of people with malaria parasites in their blood, detectable by RDT

Denominator: Total individuals with a valid RDT result

Table 5.1 shows the number of valid RDT results, and the proportion of individuals testing positive for malaria, stratified by various demographic factors. Overall, malaria prevalence was 12.9% (95% CI: 12.2%-13.7%) and *P. falciparum* malaria prevalence (PfPR) was 12.6% (95% CI: 11.9%-13.4%). Malaria prevalence was highest in ages 5-24, moderate in ages 25-44, and lowest in children under five and adults over 45 years old. Individuals the rural stratum were significantly more likely to be positive for malaria (25.1% versus 11.8% in the urban stratum). Similarly, prevalence varied substantially by district, with Luba and especially Riaba having higher prevalence than Malabo and Baney. Household wealth was also an important factor, with malaria prevalence decreasing by wealth quintile.

Table 5.1: Weighted malaria prevalence in the general population

Number of valid rapid diagnostic tests (RDTs) and percentage of the population positive by RDT for any malaria parasite (malaria PR) and for *P. falciparum* (PfPR), weighted according to sampling probability.

	Valid RDTs	Malaria PR (95% CI)	PfPR (95% CI)
Age			
<5	1,713	7.7 (6.4-9.2)	7.4 (6.1-8.9)
5-14	3,709	16.0 (14.6-17.6)	15.7 (14.2-17.2)
15-24	2,412	17.4 (15.8-19.2)	17.1 (15.5-18.9)
25-34	1,834	10.8 (9.4-12.5)	10.6 (9.2-12.2)
35-44	1,366	11.3 (9.6-13.2)	11.0 (9.3-12.9)
45-54	728	8.0 (6.1-10.4)	7.6 (5.8-9.8)
55+	821	6.4 (4.7-8.5)	5.9 (4.4-8.0)
Gender			
Female	6,666	11.7 (10.8-12.7)	11.4 (10.5-12.3)
Male	5,917	14.4 (13.3-15.5)	14.0 (13.0-15.1)
District			
Malabo	9,622	12.4 (11.6-13.2)	12.1 (11.3-12.9)
Baney	1,666	14.0 (11.8-16.6)	13.5 (11.4-16.0)
Luba	637	17.4 (13.4-22.2)	17.3 (13.3-22.1)
Riaba	658	27.6 (23.7-31.9)	26.7 (22.8-31.0)
Wealth quintile			
Lowest	2,064	16.6 (14.6-18.8)	16.3 (14.3-18.5)
Second	2,375	14.3 (12.6-16.2)	13.9 (12.3-15.7)
Middle	2,587	13.3 (11.6-15.2)	12.9 (11.3-14.7)
Fourth	2,681	13.2 (11.6-15.0)	12.9 (11.3-14.6)
Highest	2,876	9.5 (8.1-10.9)	9.2 (7.9-10.7)
Stratum			
Rural/high transmission	4,065	25.1 (23.6-26.6)	24.6 (23.1-26.1)
Urban/low transmission	8,518	11.8 (11.0-12.6)	11.5 (10.7-12.3)
Total	**12,583**	**12.9 (12.2-13.7)**	**12.6 (11.9-13.4)**

5.1.1 Risk factors for malaria

In addition to common demographic factors, the survey collected information about various risk factors for malaria (Table 5.2). Individuals with a recent history of travel were roughly twice as likely to test positive for malaria than those with no recent travel (23.5% versus 12.3% for travel in the last two weeks). Contrary to previous BIMIS, the time when individuals came indoors was not an important risk factor, which could suggest that outdoor transmission has been reduced in 2023 compared to previous years. At the same time, those who went to bed earlier were more likely to test positive. This could be driven at least partially by age, since children are more likely both to go to bed earlier and test positive.

Table 5.2: Weighted malaria prevalence according to risk factors

Number of valid rapid diagnostic tests (RDTs) and percentage of the population positive by RDT for any malaria parasite (malaria PR) and for *P. falciparum* (PfPR) by risk factors for malaria, weighted according to sampling probability.

	Valid RDTs	Malaria PR (95% CI)	PfPR (95% CI)
2-week travel history			
No travel	12,207	12.6 (11.9-13.4)	12.3 (11.6-13.1)
Travel	352	23.5 (18.8-29.0)	23.5 (18.8-29.0)
8-week travel history			
No travel	11,758	12.1 (11.4-12.9)	11.8 (11.0-12.6)
Travel	801	24.5 (21.2-28.1)	24.5 (21.2-28.1)
Most time spent during day			
Inside neighborhood	10,993	13.3 (12.5-14.2)	13.0 (12.2-13.9)
Outside neighborhood	1,539	10.3 (8.8-12.0)	10.0 (8.5-11.7)
Most time spent at night			
Inside neighborhood	12,354	13.0 (12.2-13.8)	12.6 (11.9-13.4)
Outside neighborhood	203	11.2 (7.2-16.9)	10.6 (6.8-16.3)
When came indoors			
Before 6PM	1,416	14.1 (11.9-16.6)	13.8 (11.7-16.2)
6PM-8PM	3,379	13.6 (12.1-15.1)	13.1 (11.7-14.6)
8PM-10PM	3,787	12.5 (11.3-13.8)	12.2 (11.0-13.5)
After 10PM	2,093	13.4 (11.7-15.3)	13.1 (11.5-15.0)
When went to bed			
Before 8PM	527	17.1 (13.4-21.6)	17.1 (13.4-21.6)
8PM-10PM	4,328	14.2 (13.0-15.6)	13.8 (12.5-15.1)
10PM-12AM	5,063	11.9 (10.9-13.0)	11.6 (10.6-12.6)
After 12AM	1,602	11.2 (9.4-13.2)	11.0 (9.3-13.0)
Total	**12,583**	**12.9 (12.2-13.7)**	**12.6 (11.9-13.4)**

5.2 Malaria and anemia prevalence in high-risk groups

As has been noted in Chapter 3, some population groups are at considerably higher risk of contracting malaria, and developing severe disease, than others. These include pregnant women, infants, children under five years of age, patients with HIV/AIDS, and non-immune migrants, mobile populations, and travelers.[33] Therefore, national malaria control programs need to take additional measures to protect these groups from malaria infection, considering their specific circumstances.

5.2.1 Malaria and anemia prevalence in children

Anemia Prevalence

Percentage of people with a hemoglobin measurement < 8 grams per deciliter (g/dl). This cutoff defines moderate anemia.

Denominator: Total individuals with a valid hemoglobin result

Surveyors obtained authorization from parents or legal guardians before testing children for malaria and anemia. Table 5.3 shows the number of valid malaria and anemia tests, and percentage of positive results for children under age five, by demographic characteristics. Malaria prevalence in children under five was 7.7% (95% CI: 6.4%-9.2%), and *P. falciparum* prevalence was 7.4% (95% CI: 6.1%-8.9%). Children from households in the lowest and highest wealth quintiles were notably more and less likely, respectively, to test positive than those in the middle three quintiles. As for the general population, prevalence among children varied substantially by geography, with much higher levels in rural areas (20.2% versus 6.4% in urban areas). Anemia was uncommon, with a prevalence of 1.9% (95% CI: 1.3-2.7%).

Table 5.3: Weighted malaria and anemia prevalence in children under 5

Number of valid rapid diagnostic tests (RDTs) performed on children under 5, percentage positive by RDT for any malaria parasite (malaria PR) and for *P. falciparum* (PfPR), and number of valid hemoglobin results and percentage of this group with moderate anemia (<8g/dl). Estimates are weighted according to sampling probability.

	Malaria testing			Anemia testing	
	Valid RDTs	Malaria PR (95% CI)	PfPR (95% CI)	Valid anemia tests	Anemic (95% CI)
Age in months					
<12	161	2.8 (1.1-6.7)	2.8 (1.1-6.7)	160	2.2 (0.7-6.8)
12-23	385	6.3 (4.2-9.5)	6.3 (4.2-9.5)	384	3.0 (1.6-5.4)
24-35	380	8.5 (5.9-12.1)	7.7 (5.3-11.2)	376	0.8 (0.3-2.6)
36-47	353	8.7 (6.2-12.3)	8.4 (5.9-11.8)	350	2.4 (1.1-5.1)
48-59	434	8.9 (6.5-12.0)	8.8 (6.5-11.9)	430	1.4 (0.6-3.3)
District					
Malabo	1,349	6.8 (5.5-8.5)	6.6 (5.3-8.2)	1,336	2.1 (1.4-3.1)
Baney	226	10.5 (6.7-16.1)	10.0 (6.2-15.5)	226	0.8 (0.2-3.0)
Luba	55	16.5 (7.5-32.6)	16.5 (7.5-32.6)	55	1.3 (0.2-7.7)
Riaba	83	18.2 (10.8-29.0)	16.9 (9.8-27.7)	83	1.1 (0.1-7.6)
Wealth quintile					
Lowest	232	11.3 (7.5-16.7)	11.3 (7.5-16.7)	230	3.0 (1.3-6.7)
Second	350	7.3 (5.0-10.4)	6.5 (4.4-9.4)	348	3.2 (1.7-6.0)
Middle	384	8.9 (6.0-12.9)	8.4 (5.5-12.4)	380	1.9 (0.8-4.2)
Fourth	363	8.3 (5.6-12.1)	8.3 (5.6-12.1)	361	1.8 (0.8-3.9)
Highest	384	4.3 (2.6-7.0)	4.3 (2.6-7.0)	381	0.3 (0.0-2.4)
Stratum					
Rural/high transmission	563	20.2 (17.1-23.7)	19.9 (16.8-23.4)	558	2.5 (1.6-3.8)
Urban/low transmission	1,150	6.4 (5.1-8.1)	6.2 (4.8-7.8)	1,142	1.8 (1.2-2.8)
Total	**1,713**	**7.7 (6.4-9.2)**	**7.4 (6.1-8.9)**	**1,700**	**1.9 (1.3-2.7)**

5.2.2 Malaria and anemia prevalence in pregnant women

In total, 225 pregnant women were tested for malaria, and 224 for anemia (Table 5.4). Based on this sample, malaria prevalence was 10.9% (95% CI: 7.3%-15.9%) and anemia prevalence was 3.9% (95% CI: 1.9%-7.7%). All detected malaria infections were either *P. falciparum* or mixed. Prevalence decreased with increasing education level, and was approximately two times higher in the rural stratum than the urban stratum, with Riaba district again notably elevated. When interpreting these estimates, and especially trends, it is important to take into account the small number of pregnant women tested (especially in subgroups).

Table 5.4: Weighted malaria and anemia prevalence in pregnant women

Number of pregnant women with a valid rapid diagnostic test (RDT) result, percentage positive by RDT for any malaria parasite (malaria PR) and for *P. falciparum* (PfPR); number of pregnant women with valid hemoglobin results and percentage with moderate anemia (hemoglobin <8 g/dl). Estimates are weighted according to sampling probability.

	Malaria testing			Anemia testing	
	Valid RDTs	Malaria PR (95% CI)	PfPR (95% CI)	Valid anemia tests	Anemic (95% CI)
Age					
15-24	89	14.1 (8.0-23.6)	14.1 (8.0-23.6)	89	6.7 (2.9-15.1)
25-34	104	7.4 (3.5-14.8)	7.4 (3.5-14.8)	103	2.7 (0.8-9.2)
35-44	31	13.2 (4.4-33.1)	13.2 (4.4-33.1)	31	0.0
45-54	1	100.0	100.0	1	0.0
District					
Malabo	169	11.0 (7.0-16.9)	11.0 (7.0-16.9)	168	2.6 (1.0-6.7)
Baney	35	9.8 (3.0-27.8)	9.8 (3.0-27.8)	35	6.8 (1.8-23.1)
Luba	10	0.0	0.0	10	28.3 (2.6-85.5)
Riaba	11	37.2 (12.8-70.4)	37.2 (12.8-70.4)	11	0.0
Education level					
At most primary	17	24.0 (6.6-58.7)	24.0 (6.6-58.7)	17	14.5 (2.3-55.4)
Secondary	81	13.2 (7.0-23.4)	13.2 (7.0-23.4)	80	3.6 (1.1-11.1)
Post-secondary	69	1.1 (0.4-3.2)	1.1 (0.4-3.2)	69	3.6 (0.9-13.5)
Unknown	51	17.4 (8.9-31.3)	17.4 (8.9-31.3)	51	3.1 (0.6-15.2)
Wealth quintile					
Lowest	32	18.8 (7.7-38.9)	18.8 (7.7-38.9)	31	2.2 (0.6-7.9)
Second	46	9.5 (3.6-22.7)	9.5 (3.6-22.7)	46	5.3 (1.3-19.3)
Middle	57	2.8 (1.2-6.4)	2.8 (1.2-6.4)	57	5.5 (1.7-16.3)
Fourth	49	18.4 (9.3-33.2)	18.4 (9.3-33.2)	49	5.0 (1.2-18.3)
Highest	41	9.3 (3.1-24.4)	9.3 (3.1-24.4)	41	0.0
Stratum					
Rural/high transmission	65	21.3 (13.5-32.1)	21.3 (13.5-32.1)	65	6.1 (2.6-13.9)
Urban/low transmission	160	10.0 (6.3-15.7)	10.0 (6.3-15.7)	159	3.7 (1.7-8.0)
Total	**225**	**10.9 (7.3-15.9)**	**10.9 (7.3-15.9)**	**224**	**3.9 (1.9-7.7)**

5.3 Trends in malaria prevalence

Trends in malaria prevalence can be particularly important in evaluating the impact of interventions or identifying gaps in malaria control. Figure 5.1 shows the evolution of *P. falciparum* prevalence in the general population by stratum since 2015. Island-wide prevalence has closely mirrored the urban stratum (due to its much larger population), while the rural stratum has varied more but has been consistently higher. In the urban stratum, increases were observed from 2016-2019, but prevalence stabilized around 13% from 2019-2022 (with the exception of 2020, when a reduction in travel due to COVID-19 contributed to lower overall prevalence — see section 5.4 for more details), and decreased to 11.5% in 2023. Of particular note is that the decrease in PfPR from 2022 to 2023 is driven by a decrease in the urban stratum, while the rural stratum remained at levels indistinguishable from 2022.

	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bioko Island	12.7%	8.9%	10.2%	10.6%	13.4%	11.9%	13.7%	14%	12.6%
Rural/high transmission	19.2%	11%	18.4%	12.5%	18.7%	23.1%	23.7%	24.2%	24.6%
Urban/low transmission	12.1%	8.7%	9.4%	10.4%	12.9%	10.8%	12.7%	13%	11.5%

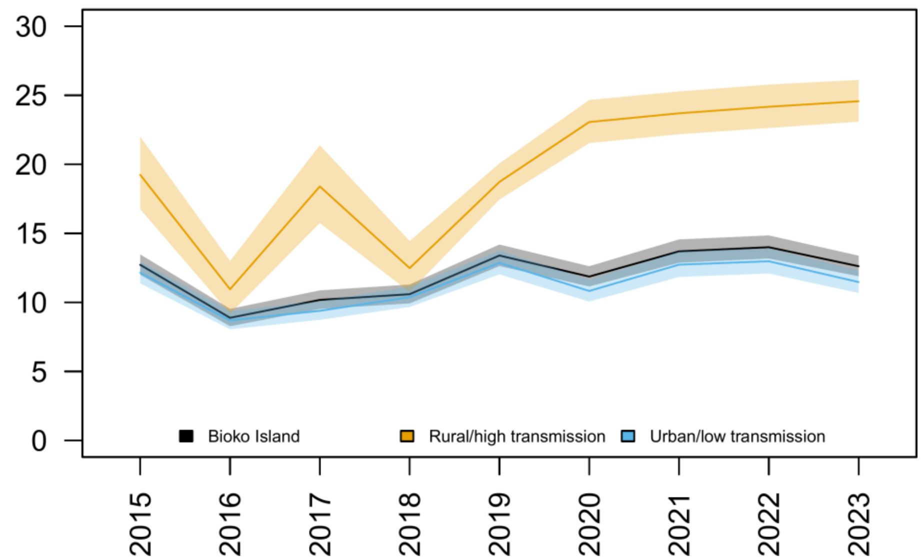


Figure 5.1: Historical trend in PfPR in the general population

All-age weighted prevalence of *P. falciparum* on Bioko Island, and in each of the two strata defined for the BIMIS from 2015-2023. Note that strata have been retroactively applied to data from 2015-2018, when strata were not explicitly used for sampling.

5.3.1 Trends in prevalence among vulnerable groups

Prevalence of *P. falciparum* among the most vulnerable groups show broadly similar trends (Figure 5.2). Children under five have consistently had a lower prevalence of malaria than those age 5-14. In both groups, there were modest increases from 2017-2019, but prevalence remained mostly stable from 2019-2022, and in 2023 fell to levels similar with the 2020 low coinciding with COVID-19. Prevalence among pregnant women is more uncertain, due to the small number of pregnant women tested, but appears to have distinct trends from children. From 2019-2021, and especially between 2021 and 2022, PfPR in pregnant women increased. The drastic change from 2021 to 2022 was reversed in 2023, suggesting that this was likely a data anomaly (e.g. caused by random chance in the sampling), although some changes in the strategy for outreach to pregnant women in 2023 could have contributed to the decrease in 2023.

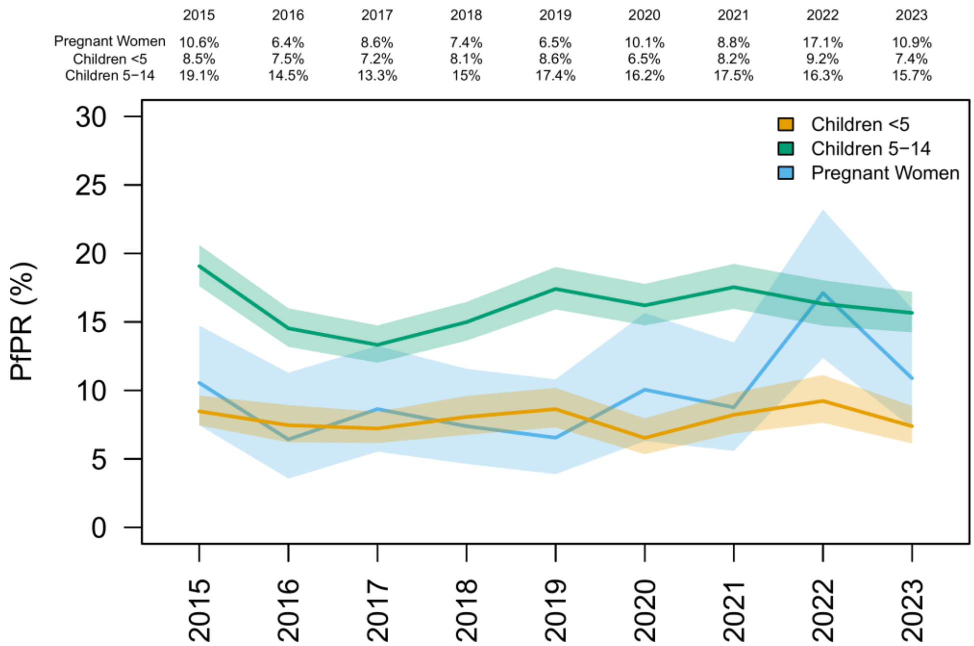


Figure 5.2: Historical trend in PfPR among children and pregnant women

Weighted prevalence of *P. falciparum* among vulnerable groups, including children under five years old, children 5-14 years old, and pregnant women from 2015-2023.

5.3.2 Spatial trends in prevalence

Transmission and risk of malaria is highly spatially heterogeneous, as Figure 5.3 shows. Since 2019, in particular much of the west and southeast coasts of the island have been consistent hot-spots for malaria prevalence. By contrast, prevalence is generally much lower in urban Malabo (with some exceptions on the urban periphery) and all of Baney district. As interpretation of longer-term trends at small spatial scales (such as PSUs) is difficult, aggregation into districts can reveal important trends, as shown in Figure 5.4. Widespread resurgence in malaria prevalence was observed in Baney, Luba and Riaba districts from 2018-2021, but this has been mostly controlled in Baney and Luba districts since 2021. Despite scale-up of interventions island-wide since 2021, prevalence has continued to climb in Riaba district through 2023. On the other hand, trends in Malabo district do not show sustained resurgence, rather a notable increase in 2019 and stabilization at this new level (with the exception of a temporary reduction in 2020, likely driven by COVID-19) until a decrease in 2023.

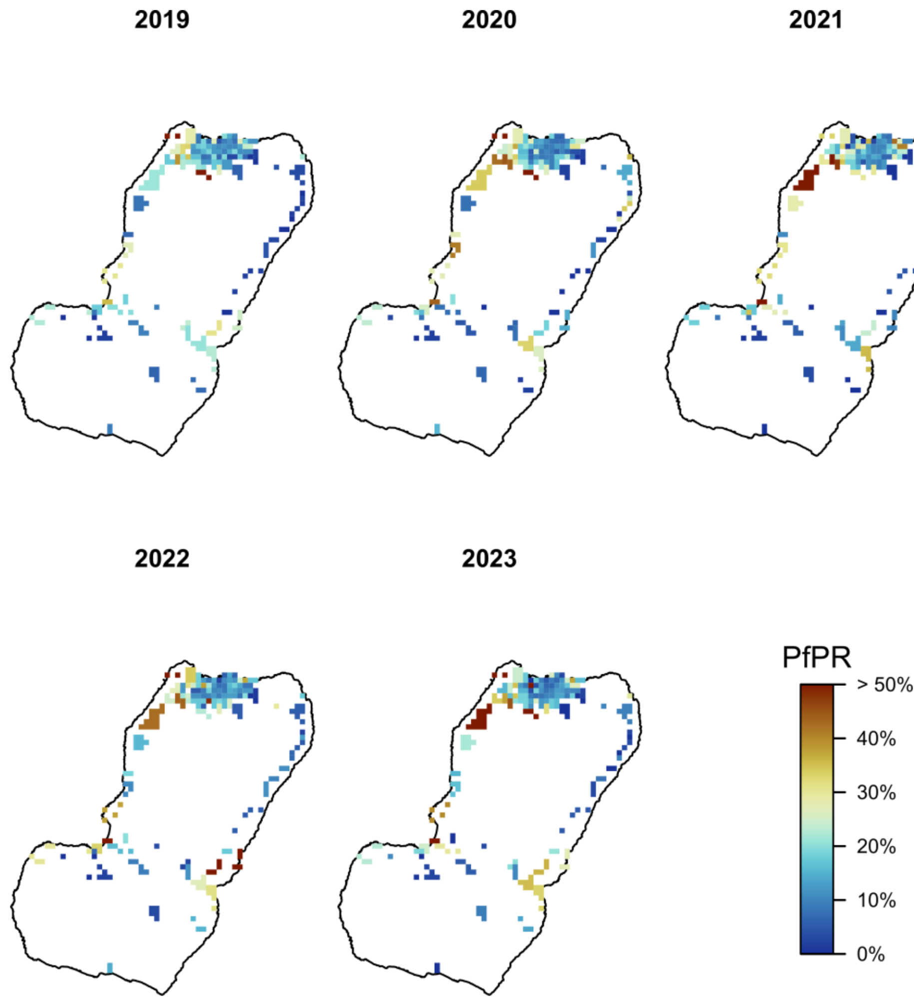


Figure 5.3: Spatial trend in PfPR

Weighted all-age *P. falciparum* prevalence by primary sampling unit from 2019-2023.

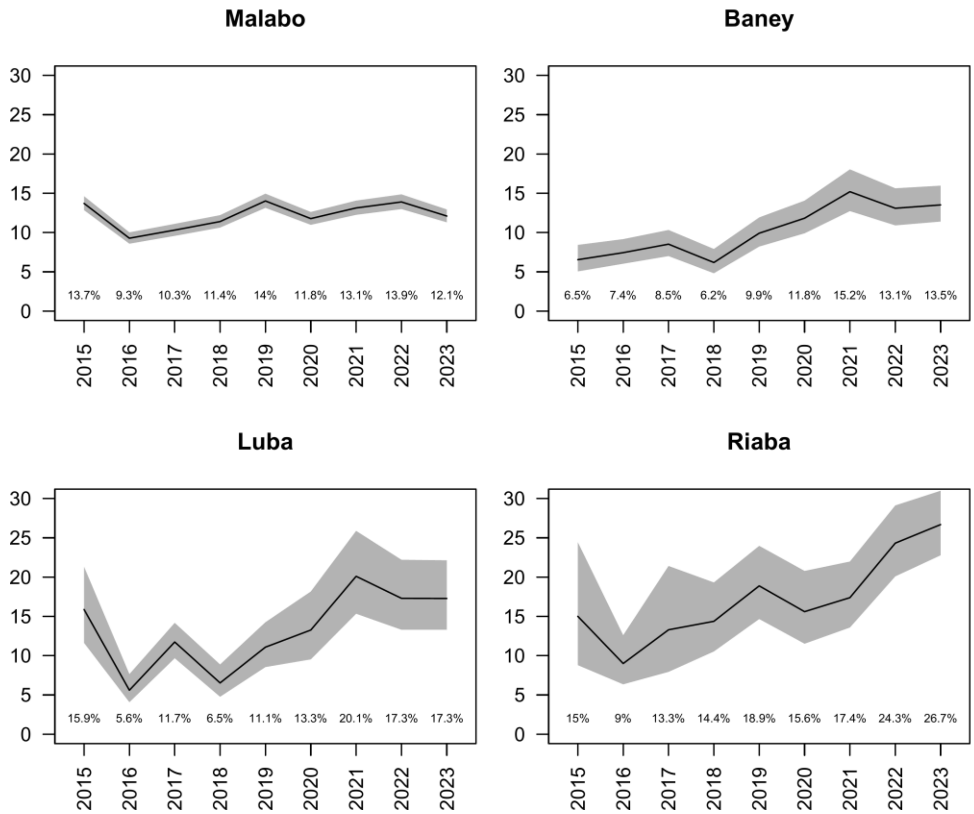


Figure 5.4: Historical PfPR by district

Weighted all-age *P. falciparum* prevalence by district from 2015-2023.

5.3.3 Trends in prevalence in children age 2-14 years

Between 2004 and 2014, malaria prevalence was assessed almost exclusively in children aged 2-14 years living in the historical sentinel sites. From 2015, the MIS was extended to the whole island, and prevalence was measured in all age groups. Hence, for consistent historical comparisons before 2015 it is necessary to consider only prevalence among children aged 2-14 years (Figure 5.5). PfPR dropped dramatically from 2004-2017, then slightly increased from 2017-2019, remained stable from 2019-2022, and somewhat decreased in 2023. The decrease observed in 2023 was the first notable decline since 2017, with the possible exception of 2020 (related to COVID-19).

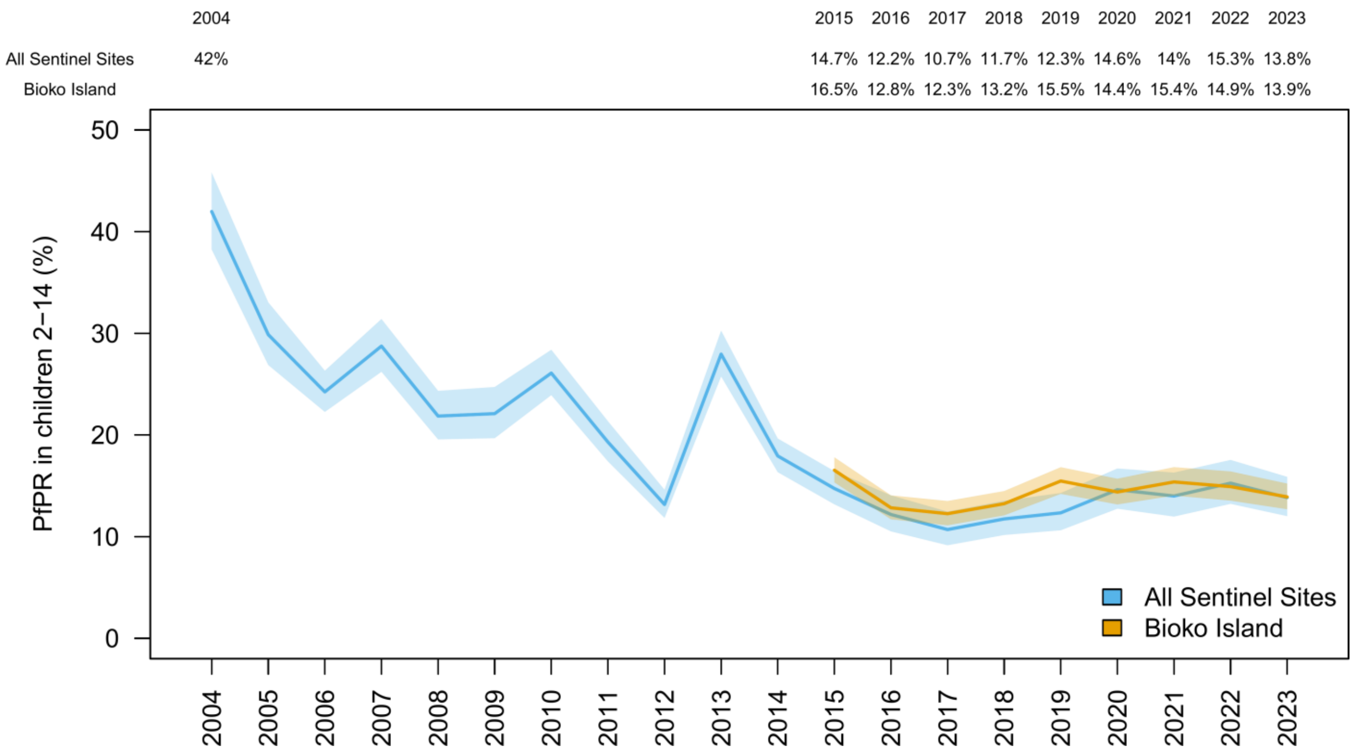


Figure 5.5: Historical trend in PfPR among children 2-14 years old

Weighted *P. falciparum* prevalence among children age 2-14 years in sentinel sites from 2004-2023. From 2015, once this information is available island-wide prevalence is reported for comparison.

5.4 Malaria and travel

As has been reported above, one of the largest risks for malaria infection on Bioko is a recent history of travel off-island (in most cases to mainland Equatorial Guinea). Travel and imported malaria infections are an important consideration for malaria control programs, especially as they approach elimination and imported infections become more common than locally transmitted infections. Previous studies on Bioko Island have characterized human mobility patterns between Bioko and mainland EG and estimated malaria proportions imported from the mainland.[17–19]

In 2020, the Government of EG imposed a travel restriction as a containment measure of the COVID-19 pandemic. As a result, the proportion of the population which traveled outside Bioko Island in the 8 weeks preceding the survey dramatically decreased from 11.3% in 2019 to only 2% in 2020, and has since partially recovered to an estimated 8.3% in 2023 (Figure 5.6). Regardless of changing travel patterns, PfPR has consistently been significantly higher among survey participants with recent history of off-island travel compared to those without recent travel. In 2020, corresponding to the reduction in travel prevalence, there was a small decrease in overall PfPR but notably PfPR among non-travelers declined only slightly (12.1% to 11.5%). This suggests that despite small observed changes in prevalence, malaria transmission on Bioko Island was consistent from 2019-2022. However, in 2023, there was a substantial decline in non-traveler prevalence (from 13.1% to 11.8%), suggesting that the decreases in prevalence observed in the general population can likely be attributed to reductions in local malaria transmission in 2023.

	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bioko Island	12.7%	8.9%	10.2%	10.6%	13.4%	11.9%	13.7%	14%	12.6%
Non−travelers	10.7%	7%	8.2%	9.2%	12.1%	11.5%	13.5%	13.1%	11.8%
Travelers	25.8%	19.7%	24.4%	25.2%	24.6%	31.3%	21.3%	28.2%	24.5%
Travel prevalence	15%	18.2%	16.1%	11.3%	11.3%	2%	3.7%	7.1%	8.3%

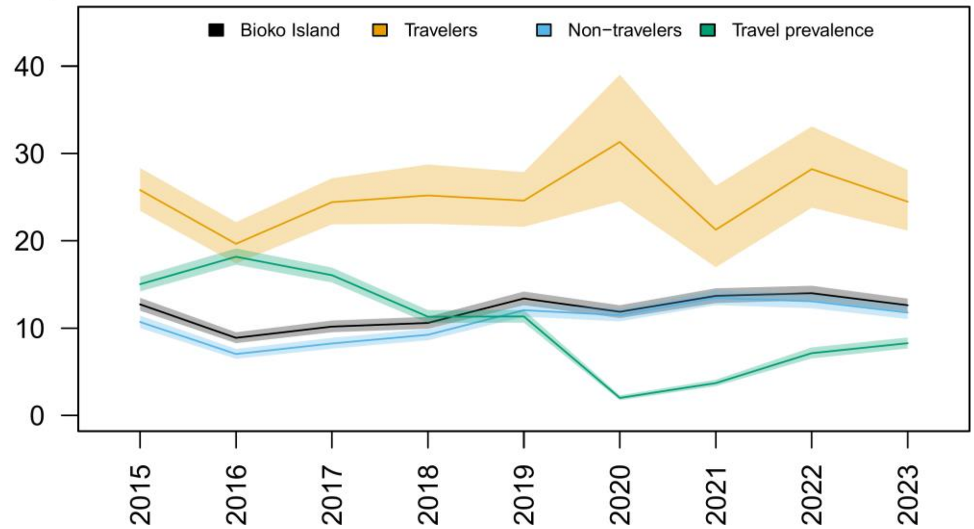


Figure 5.6: Historical trend in malaria prevalence and travel

Weighted all-age *P. falciparum* prevalence among individuals with a history of travel outside of Bioko Island in the last 8 weeks (travelers), those without a recent history of travel (non-travelers), the general population, and the proportion of the population reporting a recent history of travel outside Bioko (travel prevalence) from 2015-2023.

6 MALARIA KNOWLEDGE, ATTITUDES AND PRACTICE

Key Findings

- **Exposure to malaria messages:** Slightly under half (44.7%) of respondents heard or saw a malaria-related message in the six months preceding the survey
- **Knowledge of malaria transmission and symptoms**: Four in five respondents (81.6%) reported that mosquitos are responsible for malaria transmission, and 75.7% mentioned fever as a symptom of malaria
- **Knowledge of malaria prevention:** Sleeping under an ITN was the most cited method to prevent malaria (72.0%), and IRS was seldom mentioned (16.7%) as a way to prevent malaria
- **Awareness of free resources in public health facilities:** Three in five respondents (59.5%) were aware that malaria treatment is available free of charge in public health facilities and 41.4% and 78.5% were aware that pregnant women can receive IPTp and ITNs free of charge in public health facilities, respectively

Information about the knowledge, attitudes and practices (KAP) of the population with respect to malaria is crucial in identifying priorities and designing strategies for social, behavioral change communication (SBCC) and more generally information, education and communication (IEC) activities. These activities are a core aspect of malaria control, since IEC can help increase uptake of interventions and more broadly foster community involvement in malaria prevention and control.

This chapter presents a range of results related to malaria KAP on Bioko Island. This includes exposure to malaria messages, basic knowledge about malaria prevention, transmission, and symptoms, and awareness of interventions available on Bioko Island. Additionally, results are presented for perception of the risk of malaria on mainland EG compared to Bioko and precautions taken during travel, and the acceptability of new (for Bioko Island) treatment-based interventions.

6.1 Malaria messages received

Exposure to malaria-related messages

Percentage of respondents who reported having heard or seen a malaria-related message in the six months preceding the survey

Denominator: Number of survey respondents

Disseminating malaria-related messages is the primary means for conducting SBCC and IEC, and to diversify possible audiences BIMEP has utilized several dissemination channels. These include radio and television programs, short movies, flyers, posters, billboards, and sensitization in hospitals and churches. In addition, most field interventions deployed to households (e.g., IRS) and the LLIN pick-up points in Malabo include a sensitization and education component. To determine how widely malaria-related messages are spread into the population, survey respondents were asked if they heard or saw any message in the last six months preceding the survey. Those who reported seeing or hearing a malaria-related message were asked to name the source of information, and the types of messages they heard.

Overall, 44.3% of respondents reported hearing a message in the last six months (Table 6.2). This was quite consistent across districts, but significantly increased with increasing education level and household wealth. Nearly half (47.1%) of all households who heard a message reported television as a source. Other common sources included home visits by malaria agents (24.5%), health facilities (22.0%), and word of mouth via churches, markets or workplaces (14.5%). While home visits were an important source of messages, it is important to note that among households that received a home visit from malaria agents in the last six months, less than half (43.5%) reported having received a message during the home visit (Table 6.1). This is indicative of a need to improve messaging during routine malaria control activities, such as the annual IRS round during which the advanced team visits nearly all houses on the island, as part of a broader communication strategy.

By far the most common malaria message respondents reported hearing is to sleep under a bed net every night (49.9%). However, very few reported hearing related messages about nets, such as that nets protect against mosquitos (8.3%) or that ITNs are available free of charge (4.4%). Despite the fact that BIMEP conducted a nearly island-wide IRS campaign in 2023, less than one in five respondents (18.8%) reported having heard the message that IRS protects against malaria. This was much higher (35.6%) among households that reported hearing a message from a home visits — most presumably during the IRS campaign — but was still quite low. Combined, these results suggest it may be necessary to refresh the communication strategy promoting uptake of vector control interventions on Bioko Island.

Table 6.1: Message received during home visits

Percentage of respondents that reported having received a home visit from a malaria agent who reported having received a malaria message during the home visit.

	Heard Message	Didn't hear message	Not sure
District			
Malabo	44.0	47.8	8.2
Baney	44.5	45.0	10.5
Luba	31.6	58.8	9.6
Riaba	40.5	51.0	8.5
Respondent Gender			
Male	42.8	48.2	9.0
Female	44.0	47.7	8.3
Respondent Age			
15-24	33.0	50.2	16.8
25-34	44.3	47.3	8.4
35-44	47.3	45.3	7.4
45-54	47.1	49.2	3.7
55+	44.3	50.9	4.8
Respondent Education			
At most primary	34.7	60.2	5.1
Secondary	47.9	45.5	6.6
Post-secondary	45.9	46.4	7.7
Unknown	33.9	51.0	15.1
Wealth Quintile			
Lowest	39.9	52.1	8.0
Second	41.3	51.0	7.7
Middle	42.5	46.9	10.6
Fourth	48.0	43.9	8.1
Highest	45.0	46.6	8.5
Stratum			
Rural/high transmission	43.5	46.8	9.6
Urban/low transmission	43.5	48.1	8.5
Total	**43.5**	**47.9**	**8.6**

Table 6.2: Exposure to malaria messages

Percentage of respondents and number of households reporting having heard a malaria message within the last 6 months, and percentage of these households that reported hearing a message in various media. Note that multiple responses could be provided for where messages were heard.

	Heard message (%)	# households that heard message	Where heard message (%)											
			TV	Radio	SMS	Social Media	Home visit by malaria agent	Word of mouth	Poster/ pamphlet	Health Facility	Event	LLIN Distribution Point	Other	Don't know
District														
Malabo	45.0	1,644	47.1	7.2	7.6	3.5	22.7	14.1	6.1	21.8	0.3	1.8	7.8	1.0
Baney	44.8	272	51.4	18.0	4.1	0.9	34.7	15.4	4.8	23.4	0.0	0.0	6.6	0.8
Luba	37.4	126	34.4	17.3	3.4	0.5	25.9	18.4	4.1	21.9	0.0	0.0	9.5	0.5
Riaba	42.8	105	28.0	28.7	1.9	0.9	33.5	20.7	1.0	22.1	2.0	1.9	5.9	3.5
Respondent Gender														
Male	43.5	920	51.7	11.7	7.2	3.7	23.8	15.7	7.0	9.4	0.1	1.1	9.1	0.9
Female	45.6	1,227	43.7	7.3	6.7	2.6	25.1	13.6	5.0	31.2	0.3	1.8	6.5	1.1
Respondent Age														
15-24	38.5	325	35.5	7.0	7.2	3.2	21.1	14.8	10.5	25.1	0.0	0.8	12.4	0.8
25-34	46.5	751	43.1	6.0	8.0	4.4	23.8	15.1	5.8	26.9	0.5	1.8	7.5	0.9
35-44	44.5	541	52.1	8.6	7.4	2.4	25.9	16.8	5.7	19.8	0.0	1.5	5.8	1.1
45-54	44.6	263	56.7	13.6	4.7	2.2	26.9	12.2	1.7	14.8	0.6	1.4	7.0	1.2
55+	50.7	267	55.6	19.5	4.2	1.1	25.9	9.3	3.6	14.1	0.0	1.7	5.9	1.4
Respondent Education														
At most primary	33.9	165	50.3	14.2	2.3	1.2	27.0	18.2	5.0	18.6	0.4	2.1	3.1	2.3
Secondary	44.4	889	49.3	11.3	6.3	2.8	30.0	15.8	4.8	21.1	0.0	1.5	6.8	1.1
Post-secondary	51.6	729	47.8	7.1	7.5	4.2	21.7	12.5	6.8	21.7	0.4	1.4	8.8	0.6
Unknown	38.7	337	38.4	6.5	9.7	2.2	15.0	14.6	5.9	26.6	0.0	1.6	8.2	0.7
Wealth Quintile														
Lowest	34.1	389	42.4	13.0	2.2	4.0	22.4	17.9	5.6	19.9	0.0	1.8	7.7	2.5
Second	40.1	388	42.8	8.5	8.7	3.1	24.1	18.8	8.2	20.4	0.2	2.5	5.9	0.9
Middle	46.0	428	47.6	6.0	7.3	3.7	25.1	13.7	3.9	23.7	0.4	1.0	8.5	1.1
Fourth	48.8	462	50.5	10.5	7.1	2.9	26.2	10.6	5.0	24.4	0.3	1.5	5.8	0.5
Highest	54.6	480	49.7	8.7	8.1	2.1	24.2	13.3	6.4	21.1	0.3	1.0	9.7	0.5
Stratum														
Rural/high transmission	38.1	641	38.5	16.4	5.3	1.7	30.7	14.7	4.1	21.0	0.7	1.1	7.6	2.4
Urban/low transmission	45.4	1,506	47.8	8.5	7.1	3.2	24.0	14.5	5.9	22.1	0.2	1.5	7.6	0.9
Total	**44.7**	**2,147**	**47.1**	**9.1**	**6.9**	**3.1**	**24.5**	**14.5**	**5.8**	**22.0**	**0.2**	**1.5**	**7.6**	**1.0**

Table 6.3: Malaria messages heard

Among respondents who reported having heard a message, the percentage which reported hearing various types of messages. Note that multiple responses for the types of messages heard were allowed. Messages for households that reported hearing a message from a household visit included all messages reported, regardless of source.

		Type of message heard (%)																
	Number of households that heard message	Anopheles mosquitoes transmit malaria	Treatment for severe malaria is free	IRS protects against malaria	IRS is safe	Nets protect against mosquitoes	Sleep under a bed net every night	Nets are available free of charge	Nets being distributed are LLINs	Wash nets only when dirty	Don't wash nets more than 4 times/ year	Wash nets only with soap/ clean water	Dry nets in shade	Pregnant women should take IPT and use LLINs	Start IPTp in 4th month of pregnancy	Take at least 3 doses of IPTp during pregnancy	Other	Don't know
District																		
Malabo	1,928	16.2	4.7	18.6	3.9	7.8	48.6	3.7	2.1	2.1	0.8	1.6	0.8	1.5	0.2	0.3	20.5	24.2
Baney	312	26.5	9.2	19.4	3.4	12.2	57.7	9.7	3.7	3.4	1.2	3.2	0.5	3.1	1.2	1.2	19.6	19.8
Luba	170	17.8	2.3	25.4	4.5	3.7	52.3	1.1	1.1	0.4	0.0	0.4	0.0	2.3	1.9	0.0	30.2	18.8
Riaba	118	15.9	3.4	5.9	0.0	8.3	44.7	1.7	0.8	0.0	0.0	0.0	0.0	0.9	0.0	1.7	26.8	26.2
Respondent Gender																		
Male	1,090	16.7	3.5	19.1	3.5	7.5	45.2	4.4	2.1	1.5	0.3	1.1	0.4	0.7	0.0	0.0	22.8	24.9
Female	1,438	18.4	6.5	18.5	3.9	8.9	53.4	4.4	2.5	2.7	1.2	2.3	1.0	2.5	0.7	0.7	19.1	22.4
Respondent Age																		
15-24	376	23.9	3.2	13.8	4.3	5.8	49.1	3.7	3.2	2.2	1.0	1.1	0.4	1.6	0.1	0.0	16.4	26.3
25-34	864	16.2	5.7	18.1	3.7	8.4	50.0	4.6	2.8	2.2	0.8	1.9	0.8	2.8	0.9	0.8	20.2	25.1
35-44	645	16.2	5.8	20.6	3.8	8.6	49.6	4.1	1.4	1.9	0.3	1.4	0.3	1.3	0.2	0.6	23.7	23.0
45-54	324	20.4	5.0	22.6	4.6	11.6	53.1	6.3	2.8	3.1	2.2	4.4	2.2	0.4	0.0	0.0	23.4	14.9
55+	319	13.9	5.5	19.7	2.2	7.4	47.7	3.5	0.8	1.8	0.5	0.6	0.1	0.6	0.0	0.1	18.7	24.8
Respondent Education																		
At most primary	205	15.7	3.1	14.1	2.3	8.7	43.7	4.6	2.7	0.0	0.0	0.0	0.2	0.8	0.0	0.8	20.5	24.8
Secondary	1,049	19.3	6.4	18.6	3.8	9.5	54.6	3.6	2.2	2.7	0.9	2.3	0.9	2.1	0.4	0.3	19.9	20.9
Post-secondary	842	17.7	4.7	22.5	4.7	8.1	49.1	5.8	2.6	1.8	0.6	1.4	0.3	1.8	0.3	0.5	23.6	21.1
Unknown	404	14.4	4.8	13.0	2.2	5.7	42.8	2.9	1.9	2.5	1.5	2.2	1.5	1.1	0.7	0.7	16.5	34.2
Wealth Quintile																		
Lowest	492	21.5	2.9	16.0	1.6	7.1	45.0	3.5	1.0	1.8	0.0	0.8	1.0	1.7	0.3	0.0	17.3	24.9
Second	449	15.4	4.5	18.1	4.3	8.6	45.9	3.9	2.6	2.9	1.5	2.7	1.3	1.8	0.6	0.4	19.1	26.4
Middle	500	13.4	6.4	17.7	4.3	8.1	49.5	3.6	2.1	2.4	0.3	1.8	0.6	0.8	0.3	1.0	21.2	25.1
Fourth	539	16.8	6.1	21.1	5.0	9.7	53.3	5.3	2.7	2.6	1.4	1.5	0.3	1.6	0.2	0.5	18.4	22.4
Highest	548	21.3	5.5	20.0	3.2	7.7	53.4	5.3	2.8	1.4	0.7	2.1	0.5	2.5	0.5	0.2	26.0	19.7
Stratum																		
Rural/high transmission	819	18.4	4.4	16.3	3.9	8.3	43.2	2.1	1.8	1.0	0.2	1.0	0.7	0.9	0.2	0.2	27.3	26.1
Urban/low transmission	1,709	17.6	5.3	19.0	3.7	8.3	50.5	4.6	2.3	2.3	0.9	1.9	0.7	1.8	0.4	0.5	20.1	23.2
Source of message																		
Message from home visit	876	23.5	5.1	35.6	7.4	12.1	58.2	4.1	3.1	4.5	2.0	2.7	1.3	2.9	0.5	0.9	20.4	18.4
No message from home visit	1,402	15.4	5.2	10.5	2.0	6.2	46.0	4.8	2.0	1.2	0.3	1.4	0.5	1.3	0.4	0.3	20.7	25.5
Total	**2,528**	**17.7**	**5.2**	**18.8**	**3.8**	**8.3**	**49.9**	**4.4**	**2.3**	**2.2**	**0.8**	**1.8**	**0.7**	**1.7**	**0.4**	**0.4**	**20.7**	**23.5**

6.2 Knowledge of malaria symptoms, transmission and prevention

Knowledge of malaria symptoms

Percentage of respondents who reported that particular symptoms are signs of malaria (note that multiple responses were allowed)

Denominator: Number of survey respondents

Knowledge of malaria transmission

Percentage of respondents who reported that malaria is transmitted by mosquitos (note that multiple responses were allowed)

Denominator: Number of survey respondents

Knowledge of ways to prevent malaria

Percentage of respondents who reported that malaria could be avoided/prevented in various ways (note that multiple responses were allowed)

Denominator: Number of survey respondents

Awareness of the common symptoms of malaria, how it is transmitted and how to prevent may be important factors in the acceptance and use of malaria prevention and control activities. When asking respondents what knowledge they had in each of these categories, surveyors were instructed to prompt for additional responses, and all responses were recorded in the survey.

As Table 6.4 shows, knowledge of basic malaria symptoms was quite high. Three of every four respondents (75.7%) reported fever as a symptom of malaria, and more than half (60.0%) identified headache as a symptom. Awareness of malaria symptoms was lowest in households with lower wealth and education levels, so also varied by district, but remained high in all demographic groupings. Similarly, as summarized in Table 6.5, awareness that malaria is transmitted by the bite of a mosquito was very high (81.6%). This was again only moderately decreased in households with lower wealth or education levels.

When asked about how to prevent or avoid malaria, most respondents reported bed nets (72.0%). A much lower proportion indicated that eliminating solid waste (33.8%) or IRS (16.7%) could help prevent malaria. Given the widespread use of IRS across Bioko Island for the last 20 years, the low awareness of IRS as a malaria prevention measure is concerning. However, this may be partially caused by how the question is worded; respondents are asked what the best ways to prevent or avoid malaria are. It is possible that many respondents interpreted this to mean what they *personally* can do, which does not include spraying their own house with IRS. Nevertheless, the low penetration of IRS-related messages presented above may be consistent with low awareness of IRS as a malaria prevention measure, and is likely to impact the acceptance of IRS.

Table 6.4: Knowledge of malaria symptoms.

Percentage of respondents who were aware of various malaria symptoms. Note that multiple responses were allowed.

	Fever	Headache	Vertigo/ dizziness	Joint pain	Chills	Cough	Diarrhea	Vomiting	Pallor/ weakness	Convulsions	Loss of appetite	Sweating	Other	Don't know
District														
Malabo	77.5	60.5	3.1	16.7	10.6	1.8	4.0	19.2	23.5	0.7	5.7	1.0	12.1	7.1
Baney	68.6	58.5	6.8	12.2	15.5	1.3	2.5	15.4	23.5	0.2	5.8	0.9	12.1	7.3
Luba	63.4	56.6	1.4	21.7	15.6	1.5	3.0	19.0	19.2	0.2	4.7	0.5	13.0	10.3
Riaba	65.7	53.8	2.8	12.5	14.8	0.4	2.0	14.7	24.9	0.0	4.4	0.4	15.7	11.4
Respondent Gender														
Male	72.1	54.7	2.9	17.3	9.6	1.8	3.6	12.6	23.2	0.3	5.8	1.2	11.7	9.7
Female	78.5	64.1	4.0	15.4	12.9	1.6	3.9	23.2	23.6	0.8	5.6	0.8	12.5	5.5
Respondent Age														
15-24	76.5	58.2	5.3	8.6	9.9	2.5	4.2	18.8	27.7	0.3	3.3	0.5	13.7	8.3
25-34	80.8	63.5	3.5	14.0	9.9	1.4	4.0	20.6	23.3	0.7	5.8	1.0	10.4	6.9
35-44	75.6	59.1	3.1	20.2	13.1	1.5	3.2	18.3	23.2	0.7	6.1	1.3	12.7	6.0
45-54	69.0	61.0	2.1	20.5	13.3	1.9	4.0	15.9	21.3	0.0	5.1	1.0	12.0	7.9
55+	64.0	51.7	3.0	23.6	13.8	1.0	3.0	15.2	18.7	1.0	8.9	0.8	14.1	9.3
Respondent Education														
At most primary	66.6	49.1	2.7	21.2	14.7	1.8	3.2	14.0	17.3	0.2	5.3	0.5	12.5	11.8
Secondary	73.6	62.9	4.0	16.1	11.5	1.8	3.3	18.5	22.6	0.6	5.6	1.1	11.5	7.1
Post-secondary	82.0	63.8	3.5	16.4	10.0	1.6	5.1	20.1	27.3	0.7	5.8	1.0	12.8	4.5
Unknown	73.3	52.1	3.1	14.0	12.2	1.5	2.6	19.0	21.1	0.5	5.8	0.7	12.2	10.5
Wealth Quintile														
Lowest	70.0	50.6	2.8	16.1	13.3	1.8	3.9	14.0	19.6	0.4	4.1	0.3	11.4	11.1
Second	72.3	57.8	3.1	15.7	11.0	1.7	2.8	17.8	21.5	0.3	5.1	1.1	11.1	8.5
Middle	74.4	61.5	3.5	17.1	11.7	1.8	3.6	20.6	23.5	0.4	6.4	1.7	13.4	6.8
Fourth	79.8	63.1	3.8	15.7	11.4	1.3	3.4	20.3	23.6	0.5	5.5	0.5	10.9	6.0
Highest	82.2	67.1	4.4	16.6	10.0	1.8	5.0	20.5	28.9	1.3	7.1	1.1	13.9	3.9
Stratum														
Rural/high transmission	72.1	55.9	2.6	18.2	11.0	1.3	3.9	18.1	22.2	0.8	4.9	0.8	16.3	9.1
Urban/low transmission	76.1	60.4	3.6	16.0	11.5	1.7	3.7	18.7	23.5	0.5	5.7	1.0	11.7	7.1
Total	**75.7**	**60.0**	**3.5**	**16.2**	**11.5**	**1.7**	**3.7**	**18.6**	**23.4**	**0.6**	**5.6**	**0.9**	**12.1**	**7.3**

Table 6.5: Knowledge of malaria transmission

Percentage of respondents who report that malaria is transmitted by various routes. Note that multiple responses were allowed.

	Mosquitoes	Person-to-person	Poor personal hygiene	Contaminated water	Contaminated food	Stagnant water	Traditional disease	Other	Don't know
District									
Malabo	81.2	1.2	5.4	2.8	3.2	5.4	0.0	7.3	13.0
Baney	84.2	0.8	7.7	2.6	4.3	8.9	0.0	3.4	10.5
Luba	80.3	0.4	5.1	2.2	1.6	1.6	0.0	8.0	15.8
Riaba	78.2	0.7	7.2	2.8	2.1	6.5	0.0	6.7	15.4
Respondent Gender									
Male	79.7	0.9	5.4	2.9	3.3	4.8	0.0	7.3	13.6
Female	83.0	1.3	6.0	2.6	3.3	6.4	0.0	6.3	12.1
Respondent Age									
15-24	81.0	0.8	6.3	1.7	2.6	4.2	0.0	6.2	12.9
25-34	83.5	0.8	5.9	2.3	3.6	6.1	0.0	6.6	11.9
35-44	81.3	1.2	4.7	3.7	3.7	5.7	0.0	7.9	12.8
45-54	82.3	1.2	5.6	3.8	4.0	6.7	0.0	7.3	10.8
55+	75.5	2.1	6.7	2.5	2.2	6.2	0.0	5.0	17.7
Respondent Education									
At most primary	69.8	1.9	5.2	4.1	3.6	3.9	0.0	9.5	21.6
Secondary	81.2	1.5	6.0	3.1	4.1	6.6	0.0	6.2	12.3
Post-secondary	87.8	0.7	5.5	2.1	3.1	6.0	0.0	7.0	8.1
Unknown	76.7	0.6	5.3	2.4	2.1	3.8	0.0	6.2	18.2
Wealth Quintile									
Lowest	73.2	0.6	3.6	2.6	2.9	5.3	0.0	6.6	20.7
Second	79.1	1.5	6.2	2.5	3.1	5.6	0.0	8.0	13.6
Middle	81.0	1.2	6.5	3.4	3.5	5.7	0.0	7.2	13.2
Fourth	83.9	0.7	6.6	2.8	4.3	6.5	0.0	6.1	10.9
Highest	90.7	1.4	5.7	2.5	2.9	5.6	0.0	5.9	5.4
Stratum									
Rural/high transmission	78.2	0.8	4.9	3.3	3.0	4.8	0.0	10.6	16.1
Urban/low transmission	81.9	1.1	5.8	2.7	3.3	5.8	0.0	6.4	12.4
Total	**81.6**	**1.1**	**5.7**	**2.7**	**3.3**	**5.7**	**0.0**	**6.8**	**12.7**

Table 6.6: Knowledge of malaria prevention

Percentage of respondents who were aware of various malaria prevention methods. Note that multiple responses were allowed.

	Can't be prevented	Use bed nets	IRS	Preventative medication	Eliminate solid waste	Keep doors/windows closed	Install screens on doors/windows	Other	Don't know
District									
Malabo	0.5	71.8	17.1	8.5	33.5	5.8	1.5	18.8	9.3
Baney	0.2	74.2	15.4	7.5	35.9	3.4	1.1	14.4	8.5
Luba	0.0	70.6	15.3	12.2	32.2	1.3	0.4	19.9	11.8
Riaba	0.4	67.5	8.5	7.7	32.5	0.4	1.2	15.2	16.0
Respondent Gender									
Male	0.3	66.1	17.1	9.4	33.6	5.3	1.5	20.6	10.0
Female	0.6	76.6	16.5	7.7	33.9	5.3	1.4	16.4	8.9
Respondent Age									
15-24	0.5	72.9	15.2	8.6	28.4	5.6	1.3	18.4	11.0
25-34	0.6	71.6	18.1	7.5	35.6	4.9	1.3	17.5	9.5
35-44	0.6	72.6	17.6	8.3	35.7	5.6	1.5	19.1	8.1
45-54	0.0	72.7	15.9	8.3	32.2	5.6	2.6	20.0	8.1
55+	0.4	69.8	13.8	12.1	34.8	4.9	0.7	15.7	10.5
Respondent Education									
At most primary	0.8	68.3	11.8	11.7	25.4	2.3	0.9	15.5	14.4
Secondary	0.4	76.0	15.3	8.5	32.1	3.8	1.2	17.1	8.2
Post-secondary	0.5	69.6	21.8	7.5	40.7	8.2	2.3	22.0	6.7
Unknown	0.5	69.9	13.5	8.4	29.9	5.0	0.8	15.6	13.3
Wealth Quintile									
Lowest	0.3	67.8	8.7	8.5	26.4	2.9	0.6	15.8	14.0
Second	0.5	72.5	15.8	8.2	28.2	3.3	0.9	18.8	11.0
Middle	0.6	74.6	15.6	7.9	34.9	3.5	1.0	16.7	8.6
Fourth	0.9	74.0	19.3	8.0	36.9	4.3	1.6	17.6	7.7
Highest	0.0	71.2	24.4	9.6	42.6	12.3	3.2	22.0	5.3
Stratum									
Rural/high transmission	0.4	68.1	15.5	10.3	29.9	5.1	0.9	22.6	12.6
Urban/low transmission	0.5	72.5	16.9	8.3	34.2	5.3	1.5	17.7	9.0
Total	**0.5**	**72.0**	**16.7**	**8.4**	**33.8**	**5.3**	**1.4**	**18.2**	**9.3**

6.3 Awareness and acceptance of available interventions

The BIMEP collaborates with the NMCP to provide a range of malaria prevention and treatment interventions free of charge on Bioko Island, including IRS, ITN distributions, and both preventative (for pregnant women) and curative treatments. Awareness of the availability of these resources, and their acceptance among the population, is key to reducing the malaria burden.

6.3.1 Awareness of free resources at health facilities

Knowledge of free resources at health facilities:

Percentage of respondents who were aware that ACT (treatment), IPTp (preventative treatment in pregnancy) and ITNs for pregnant women are available free of charge in public health facilities

Denominator: Number of survey respondents

Currently, three resources are provided free of charge in public health facilities: diagnosis and treatment of malaria for the entire population, and IPTp-SP and ITNs for pregnant women. To assess awareness of these resources, respondents were asked if they knew whether public facilities provide treatment, or IPTp-SP and ITNs for pregnant women, free or at a cost to the patient. Awareness of free ITNs for pregnant women was highest (78.5%), followed by awareness of free malaria treatment (59.5%) and free IPTp-SP (41.4%). Awareness of all these resources was lower among respondents with at most a primary level of education, or those from households with a lower income level. Overall, women had a higher level of awareness than men, and this difference was especially pronounced for knowledge of free IPTp-SP (23.6% in men versus 54.9% in women). With the exception of lower awareness of free ACTs for malaria treatment in Malabo and Baney (possibly influenced by lower transmission in greater Malabo than Bioko Sur), awareness was quite consistent across districts and survey strata.

Table 6.7: Awareness of interventions available free of charge at public health facilities

Percentage of respondents who report treatment for malaria (ACTs), IPT for pregnant women, and ITNs for pregnant women are provided free of charge in public health facilities.

	ACTs	IPT for pregnant women	ITN for pregnant women
District			
Malabo	58.4	39.9	78.2
Baney	62.3	49.6	79.9
Luba	71.2	41.3	80.7
Riaba	71.8	48.7	77.8
Respondent Gender			
Male	50.6	23.6	68.9
Female	66.3	54.9	85.8
Respondent Age			
15-24	56.4	37.0	77.8
25-34	62.3	45.9	81.9
35-44	56.8	42.8	76.9
45-54	61.4	41.7	75.8
55+	60.2	29.2	74.7
Respondent Education			
At most primary	50.3	29.9	67.0
Secondary	60.8	42.4	78.9
Post-secondary	60.9	42.1	79.1
Unknown	59.1	45.0	82.4
Wealth Quintile			
Lowest	48.8	32.2	69.4
Second	58.1	39.7	79.9
Middle	64.8	45.8	83.5
Fourth	63.6	46.4	81.4
Highest	62.3	42.9	78.2
Stratum			
Rural/high transmission	61.8	40.2	77.1
Urban/low transmission	59.3	41.5	78.6
Total	**59.5**	**41.4**	**78.5**

6.3.2 Knowledge of IPTp timing and duration

Knowledge of ITPp timing and duration:

Percentage of respondents who were aware that ITPp should be started in the second trimester (i.e., fourth month) of pregnancy, and that at least three doses of IPTp should be taken

Denominator: Number of survey respondents

In order to be most effective, IPTp-SP should be taken at least three times during the pregnancy, beginning in the second trimester.[29] Accordingly, the survey included questions to assess knowledge of the population of the correct timing and duration of IPTp. As Table 6.8 shows, exceedingly few respondents correctly identified the second trimester as the time to begin IPTp-SP, with a majority reporting they did not know (71.7%). Awareness among women was somewhat higher, but still quite low, with only 8.6% correctly identifying the 4th month of pregnancy.

Table 6.8: Awareness of when pregnant women should start IPTp

Percentage of respondents who report that pregnant women should begin taking IPTp by month of first dose.

	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	Don't know
District										
Malabo	4.0	1.5	12.9	4.8	1.7	1.9	0.3	0.1	0.1	72.6
Baney	3.7	1.6	14.5	9.7	2.4	2.0	0.2	0.0	0.0	65.9
Luba	4.1	0.8	15.4	6.0	1.1	0.0	0.0	0.0	0.0	72.6
Riaba	3.2	0.4	7.1	8.2	1.6	2.1	0.8	0.4	0.0	76.3
Respondent Gender										
Male	1.9	0.7	3.9	1.6	0.4	0.4	0.2	0.0	0.1	90.8
Female	5.5	2.0	20.2	8.6	2.9	2.9	0.4	0.1	0.1	57.2
Respondent Age										
15-24	4.1	1.3	10.0	5.7	1.3	1.6	0.3	0.0	0.1	75.5
25-34	5.0	1.7	15.9	7.2	2.8	2.6	0.3	0.2	0.2	64.2
35-44	4.3	2.1	15.0	5.1	1.7	1.7	0.3	0.0	0.1	69.6
45-54	2.7	0.7	11.5	3.7	0.5	1.0	0.3	0.0	0.0	79.6
55+	0.6	0.3	6.3	2.9	0.8	1.0	0.3	0.0	0.0	87.8
Respondent Education										
At most primary	2.8	0.2	8.4	3.5	1.0	0.7	0.3	0.1	0.0	83.0
Secondary	3.7	1.4	14.6	5.5	1.7	1.8	0.2	0.1	0.1	70.9
Post-secondary	4.0	1.8	12.7	5.4	1.7	1.8	0.5	0.0	0.0	72.0
Unknown	5.2	1.7	13.1	6.9	2.6	2.6	0.2	0.2	0.2	67.4
Wealth Quintile										
Lowest	3.2	1.3	9.4	4.9	1.5	0.6	0.2	0.0	0.1	78.6
Second	3.3	1.7	13.2	5.3	1.4	1.3	0.2	0.2	0.0	73.4
Middle	4.3	1.4	13.7	5.4	1.9	2.7	0.7	0.2	0.1	69.5
Fourth	4.9	1.6	14.3	7.1	2.1	2.6	0.3	0.0	0.1	67.0
Highest	4.1	1.3	15.2	5.0	2.2	1.9	0.0	0.0	0.1	70.1
Stratum										
Rural/high transmission	3.1	1.6	11.2	4.3	1.4	1.4	0.5	0.2	0.0	76.2
Urban/low transmission	4.1	1.4	13.3	5.7	1.8	1.9	0.3	0.1	0.1	71.3
Total	**4.0**	**1.5**	**13.1**	**5.6**	**1.8**	**1.8**	**0.3**	**0.1**	**0.1**	**71.7**

Similarly, knowledge of the number of doses of IPTp-SP required was quite low (Table 6.9). Overall, 15.1% knew that at least three doses were required, but a large majority (76.1%) reported not knowing the correct number of doses. Awareness was again somewhat higher among women (23.3% were aware that three or more dosses were required), but still quite low.

These results show that awareness of timing and dosage of IPTp-SP required for effective protection during pregnancy is very low, even among women. While knowledge among providers may be substantially higher, resulting in higher coverage of IPTp-SP with three or more doses (see Chapter 3), awareness among the population is still important because it may influence how likely a pregnant women is to return for the required number of ANC visits to complete a full round of IPTp-SP, and at the correct time. The higher awareness among women does reflect the targeted nature of messaging about IPTp-SP, but there remains substantial work to be done to raise knowledge about IPTp-SP.

Table 6.9: Awareness of number of doses of IPTp pregnant women should take

Percentage of respondents who report that pregnant women should take different numbers of doses of IPTp

	One	Two	Three or more	Don't know
District				
Malabo	4.7	3.7	14.4	77.1
Baney	4.0	6.0	20.3	69.3
Luba	3.7	3.4	14.0	78.9
Riaba	4.8	4.4	11.8	79.0
Respondent Gender				
Male	0.7	1.2	4.4	93.5
Female	7.5	6.1	23.3	62.9
Respondent Age				
15-24	3.8	4.5	12.3	79.3
25-34	5.6	4.4	19.3	70.6
35-44	5.8	4.5	15.8	73.5
45-54	2.2	2.2	13.0	82.4
55+	1.7	2.0	6.0	89.4
Respondent Education				
At most primary	2.3	3.2	9.7	84.8
Secondary	4.2	4.7	16.1	75.0
Post-secondary	4.8	3.5	15.4	76.0
Unknown	6.1	3.3	15.5	74.6
Wealth Quintile				
Lowest	4.0	3.7	10.7	81.5
Second	3.2	4.4	12.1	80.3
Middle	4.5	3.3	16.9	74.7
Fourth	6.1	4.7	17.8	71.4
Highest	5.2	3.8	18.1	72.7
Stratum				
Rural/high transmission	4.1	3.6	12.0	80.2
Urban/low transmission	4.6	4.0	15.4	75.7
Total	**4.6**	**4.0**	**15.1**	**76.1**

6.3.3 Acceptance of IRS

Acceptance of IRS:

Percentage of respondents who reported that they would like their house sprayed in the next year

Denominator: Number of survey respondents

Reasons for rejecting IRS:

Among those who did not want IRS in the next year, the percentage that cited particular reasons for not wanting IRS (note that multiple responses were allowed)

Denominator: Survey respondents who reported not wanting their house sprayed in the next year

Since 2004, IRS has been the principal vector control intervention on Bioko Island. As such, acceptance and reasons for refusal are of key importance for malaria control efforts. As part of the BIMIS, respondents were asked if they would want their house sprayed next year. The results are presented in Table 6.10. Overall, acceptance remains high (80.9%), and was especially high in Riaba and Luba districts. While these acceptances are high, it is important to remember that some may agree in theory to having their house sprayed but refuse when the IRS team comes to spray. Unsurprisingly, reported refusal was substantially higher in Malabo, and in wealthier households or those with a post-secondary education.

Table 6.10: Acceptance of IRS

Percentage of respondents who reported wanting their house sprayed in the following year

	Accept IRS	Don't accept IRS	Not sure
District			
Malabo	79.8	11.0	9.1
Baney	83.1	6.7	10.2
Luba	95.2	2.4	2.5
Riaba	92.7	3.2	4.0
Respondent Gender			
Male	83.4	8.3	8.3
Female	79.1	11.4	9.5
Respondent Age			
15-24	71.0	11.2	17.8
25-34	80.0	11.2	8.8
35-44	83.7	9.3	7.1
45-54	87.9	8.9	3.3
55+	87.9	7.4	4.7
Respondent Education			
At most primary	86.7	6.5	6.8
Secondary	82.8	9.4	7.8
Post-secondary	78.2	11.7	10.0
Unknown	79.7	9.9	10.4
Wealth Quintile			
Lowest	83.7	9.2	7.1
Second	83.6	8.7	7.7
Middle	82.5	9.4	8.1
Fourth	80.1	11.3	8.6
Highest	74.6	11.8	13.6
Stratum			
Rural/high transmission	88.8	6.2	5.0
Urban/low transmission	80.1	10.5	9.4
Total	**80.9**	**10.1**	**9.0**

Respondents who reported not wanting their house sprayed next year were asked a follow-up question to identify reasons for refusing IRS. Table 6.11 presents the results for this question. The number of respondents is low (451 in total), but by far the most common reason cited for refusing IRS was ill health effects (42.6%). This may indicate a need for tailoring communication strategies to address the health concerns of the population with respect to IRS. Responses were generally consistent across strata, but respondents in the rural stratum reported lack of effectiveness as a reason for refusing IRS twice as often as those in the urban stratum (14.1% versus 7.2%).

Table 6.11: Reasons for not accepting IRS

Among respondents who reported not wanting their house sprayed in the following year, the percentage which reported each of the following reasons. Note that multiple responses were allowed.

	Number of households that don't want IRS	Reason for not wanting IRS (%)										
		Ill health effects	Dangerous for animals	Disruptive/ disagreeable	Attitude of sprayers	Damages to furniture/ walls	Not effective	Not applicable to us	Use bed nets instead	Time is inconvenient	Other	Don't know
District												
Malabo	393	40.6	1.0	14.1	3.2	9.2	7.8	5.6	1.6	2.5	25.7	5.4
Baney	41	61.7	0.0	6.0	3.2	15.8	6.6	3.0	0.0	0.0	16.5	6.0
Luba	9	61.1	0.0	15.3	0.0	7.3	7.3	8.0	0.0	0.0	16.2	7.4
Riaba	8	40.1	0.0	13.2	13.2	0.0	0.0	24.2	0.0	0.0	22.5	0.0
Respondent Gender												
Male	157	39.0	0.9	10.1	3.1	9.3	5.2	7.0	0.8	3.0	31.7	5.8
Female	294	44.6	0.8	15.2	3.3	9.9	9.0	4.6	1.8	1.8	20.9	5.2
Respondent Age												
15-24	93	40.3	1.3	15.3	1.5	9.7	7.1	5.7	1.3	1.2	30.0	7.1
25-34	175	41.2	0.8	12.1	2.3	3.8	11.3	4.6	2.1	4.3	22.6	5.6
35-44	104	49.7	1.2	17.9	2.9	16.6	4.7	7.1	0.0	1.4	21.4	4.0
45-54	46	35.3	0.0	7.9	5.3	18.0	6.3	5.8	3.1	0.0	31.0	5.4
55+	33	44.9	0.0	7.8	11.5	7.8	0.0	4.0	0.0	0.0	23.3	4.6
Respondent Education												
At most primary	27	54.4	0.0	6.0	1.0	0.0	10.1	0.0	5.1	0.0	22.4	11.1
Secondary	168	47.5	0.1	14.6	5.2	5.1	6.3	5.5	0.0	1.6	23.2	6.1
Post-secondary	163	37.5	2.2	15.3	1.6	16.8	6.0	7.0	2.3	3.7	24.7	3.8
Unknown	83	40.5	0.0	10.4	1.9	8.8	10.8	3.1	1.6	0.0	29.6	4.9
Wealth Quintile												
Lowest	88	48.7	1.5	8.3	1.8	7.3	6.5	4.5	0.0	1.5	25.5	8.0
Second	80	41.9	0.3	11.5	3.5	8.5	11.9	4.9	3.1	0.0	26.1	8.0
Middle	80	51.3	1.4	15.2	2.9	9.2	3.7	4.6	1.4	4.3	19.9	1.4
Fourth	99	39.0	0.0	17.8	2.4	5.6	7.9	4.1	1.2	2.6	27.3	6.5
Highest	104	34.8	1.2	12.9	5.1	16.7	8.2	8.7	1.4	2.4	24.8	3.8
Stratum												
Rural/high transmission	103	34.4	1.0	10.7	3.8	9.5	14.1	6.6	0.9	1.9	28.4	5.8
Urban/low transmission	348	43.1	0.9	13.5	3.2	9.7	7.2	5.4	1.4	2.2	24.5	5.4
Total	**451**	**42.6**	**0.9**	**13.3**	**3.2**	**9.7**	**7.6**	**5.5**	**1.4**	**2.2**	**24.8**	**5.4**

6.3.4 Acceptability of new mass treatment interventions

Acceptability of mass treatment:

Percentage of respondents who reported that they would be willing to take malaria prophylaxis during travel to mainland EG, be tested for malaria on departure to or arrival from mainland EG and take treatment in case of positive result (test and treat), or to take an antimalarial treatment even when not presenting symptoms (i.e., as part of an MDA campaign)

Denominator: Number of survey respondents

In addition to assessing the awareness and acceptance of existing interventions, since 2022 the BIMIS has included questions to assess the acceptability of new treatment-based interventions on Bioko Island. Respondents were asked if they would be willing to take malaria prophylaxis during travel to mainland EG, to submit to a malaria test and take treatment if positive during travel to or from mainland EG, or participate in mass drug administration (MDA, that is, taking treatment for malaria whether currently experiencing symptoms or not).

Table 6.12 summarizes the acceptability of these new (for Bioko Island) interventions. The travel related interventions (prophylaxis and test-and-treat during travel) had high acceptability (89.1% and 91.9%, respectively). Acceptance of these interventions varied little by demographic factors. However, acceptability of MDA was much lower (57.4%). This is likely at least partially influenced by the manner in which the question was asked ("Would you be willing to take an antimalarial, even if you do not have malaria symptoms"), and could potentially be increased with the right communication strategy emphasizing the importance of asymptomatic malaria. With these caveats, MDA had a higher acceptability in lower income households, Riaba district, and among older respondents.

Table 6.12: Acceptability of treatment-based interventions

Proportion of respondents who reported being willing (Yes) to take malaria prophylaxis during travel to mainland EG, be tested for malaria on departure to or arrival from mainland EG and take treatment if positive, or take antimalarials as part of a mass drug administration campaign.

	Prophylaxis during travel			Test and treat during travel			Mass drug administration		
	Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know
District									
Malabo	88.7	8.8	2.5	91.8	6.6	1.6	55.8	40.5	3.6
Baney	89.5	6.8	3.7	91.3	5.8	2.9	63.6	31.4	4.9
Luba	94.1	5.3	0.5	94.4	5.4	0.2	64.3	31.4	4.3
Riaba	95.5	4.0	0.4	98.0	2.0	0.0	77.8	21.4	0.9
Respondent Gender									
Male	88.3	8.8	2.8	91.5	6.6	1.9	56.2	39.9	3.8
Female	89.6	8.0	2.4	92.3	6.1	1.6	58.3	37.9	3.8
Respondent Age									
15-24	88.0	8.5	3.5	91.0	6.7	2.3	44.9	51.9	3.2
25-34	88.3	9.7	2.0	92.1	6.5	1.3	55.9	40.2	3.9
35-44	90.4	7.0	2.6	92.5	6.3	1.2	60.3	36.3	3.4
45-54	88.6	8.2	3.2	92.1	5.8	2.1	69.4	26.4	4.2
55+	90.6	6.9	2.5	91.4	5.9	2.7	65.3	29.9	4.8
Respondent Education									
At most primary	86.6	10.0	3.4	87.2	9.0	3.8	64.1	30.1	5.8
Secondary	90.8	6.5	2.7	93.0	5.4	1.6	59.9	36.3	3.8
Post-secondary	88.3	9.3	2.4	92.1	6.8	1.1	53.9	42.9	3.1
Unknown	88.0	10.0	2.0	91.6	6.7	1.8	54.5	41.6	3.8
Wealth Quintile									
Lowest	87.5	9.9	2.6	89.3	8.5	2.2	63.1	33.3	3.6
Second	87.7	9.2	3.0	91.6	7.0	1.3	57.0	38.1	4.9
Middle	90.0	7.6	2.4	93.0	6.0	1.0	57.3	38.5	4.2
Fourth	90.2	7.3	2.5	92.3	5.2	2.4	57.2	39.3	3.6
Highest	89.8	7.7	2.5	93.5	5.0	1.5	52.6	44.8	2.6
Stratum									
Rural/high transmission	92.9	5.8	1.3	94.2	4.9	1.0	61.5	35.4	3.1
Urban/low transmission	88.7	8.6	2.7	91.7	6.5	1.8	57.0	39.1	3.9
Total	**89.1**	**8.4**	**2.6**	**91.9**	**6.4**	**1.7**	**57.4**	**38.8**	**3.8**

6.4 Perception of malaria risk in Continental Region

Perception of malaria in Bioko compared to mainland EG:

Percentage of respondents who reported that Bioko Island has a higher risk of malaria than mainland EG (or *vice versa*)

Denominator: Number of survey respondents

Use of malaria prevention measures during travel to mainland EG:

Percentage of respondents with recent history of travel to mainland EG who reported that they used a bed net or any antimalarial during their travel in the next year

Denominator: *De jure* household members with travel history to mainland EG in the 8 weeks preceding the survey

Given the elevated risk for malaria among individuals with recent travel history outside Bioko Island (see Chapter 5), and in particular to mainland EG, in 2022 questions were added to the BIMIS to assess the perception of malaria risk in mainland EG, and use of preventative measures during travel. All respondents were asked if they considered Bioko Island or mainland EG to have a higher risk of malaria, and individuals who reported recent travel outside Bioko Island were asked if they used any antimalarial medications or ITNs during their travel.

As shown in Table 6.13, awareness of the elevated risk for malaria in mainland EG was relatively low. Only two in ten (21.8%) respondents reported that mainland EG had a higher risk for malaria, and the plurality (37.9.8%) were not sure. This did not vary much by demographic variables.

Table 6.13: Perception of malaria risk in regions of Equatorial Guinea

Percentage of respondents by which region of Equatorial Guinea (Bioko Island or Continental Region) they reported to have higher risk of malaria.

	Bioko Island	Continental region	Same risk	Not sure
District				
Malabo	30.4	22.3	9.1	38.2
Baney	32.4	20.9	12.3	34.4
Luba	30.1	15.1	7.8	47.0
Riaba	34.0	13.6	16.1	36.3
Respondent Gender				
Male	30.3	24.4	7.8	37.5
Female	31.1	19.8	11.0	38.2
Respondent Age				
15-24	34.7	30.7	5.4	29.2
25-34	28.9	21.9	10.1	39.1
35-44	28.2	20.7	10.3	40.7
45-54	33.9	16.1	12.1	38.0
55+	32.3	14.1	10.6	43.0
Respondent Education				
At most primary	30.0	11.4	9.2	49.5
Secondary	32.9	16.7	9.8	40.7
Post-secondary	29.9	31.2	8.2	30.7
Unknown	28.6	21.8	11.5	38.1
Wealth Quintile				
Lowest	27.0	14.9	11.2	46.8
Second	29.4	17.4	10.9	42.2
Middle	33.5	18.7	9.2	38.6
Fourth	34.9	23.6	8.1	33.4
Highest	28.7	34.4	8.4	28.5
Stratum				
Rural/high transmission	32.7	18.0	10.2	39.2
Urban/low transmission	30.5	22.2	9.5	37.8
Total	**30.7**	**21.8**	**9.6**	**37.9**

Despite low awareness of the increased risk, use of malaria prevention measures was somewhat common during travel (6.14). Around one in five (22.1%) travelers used a bed net during travel. Bed net use varied by age, with children and older adults having higher usage. Individuals from higher-income households, and from Malabo district were somewhat less likely to use nets during travel. This is somewhat concerning, since these are the groups most likely to travel outside of Bioko Island.

Table 6.14: Use of interventions during travel to mainland EG

Percentage of travelers that reported using a bed net or antimalarials during their travel to the continental region

	Used bed net	Used antimalarials	Number of travelers
District			
Malabo	20.8	7.1	764
Baney	30.1	10.2	105
Luba	21.6	9.0	35
Riaba	14.5	14.0	34
Gender			
Female	24.8	7.4	495
Male	18.9	7.9	443
Age			
<5	20.6	6.3	74
5-14	25.9	6.5	132
15-24	24.1	7.3	169
25-34	21.1	9.7	229
35-44	18.0	9.5	183
45-54	27.8	4.8	92
55+	16.9	3.5	59
Wealth Quintile			
Lowest	36.7	6.4	67
Second	31.1	8.7	115
Middle	23.2	6.5	191
Fourth	23.5	7.9	219
Highest	15.5	7.9	346
Stratum			
Rural/high transmission	21.5	9.4	281
Urban/low transmission	22.1	7.5	657
Total	**22.1**	**7.6**	**938**

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APPENDIX A: INFORMED CONSENT DOCUMENTS

Community________________________ Household_______________________________ Surveyor_________

BIOKO ISLAND MALARIA INDICATOR SURVEY

INFORMATION NOTICE

Introduction
Dear Sir/Madame, my name is___________________, I work for the National Malaria Control Program (NMCP). Every year the NMCP organizes a survey in some households on the island of Bioko. I am here because your household has been selected this year.

Survey objectives
The objectives of this survey are: (1) To know your level of knowledge about malaria, (2) To know if you have mosquito bed nets in your home and if you use them, (3) If there is a woman age between 15 and 49 in this household, to know if she took preventive medicine for malaria during her last pregnancy, (4) To know how you and your family treat yourselves when you are sick, (5) To know how many people in your household have malaria and low blood level (anemia).

In addition, this year a series of questions will be asked to determine the socio-economic status of the population. The purpose of this section of the survey is to know if the distribution of malaria control activities is equitable, and to identify if there are any socio-economic groups which may need improved access to health services.

Procedures
We will prick the finger with a small needle, and we will collect a drop of blood to test for malaria, a second drop of blood to test for anemia, and three other drops of blood that we will take to the laboratory for confirmation. Results will be available in less than 20 minutes; while waiting, we will ask you some general questions about your home and your family; we will also ask some specific questions to each woman age between 15 and 49 who is available and willing to take part.

Benefits
Your family will receive free malaria and anemia tests. We will treat people with positive malaria tests for free. We ensure that this treatment is the same that is used in government hospitals and health centers. However, we will not treat anemia because we do not know its cause, so you should consult a doctor on your own.

Potential risks
You will feel a slight pain in the finger during the prick that will last less than 20 seconds. You may not feel comfortable with some of the questions, but we want to assure you that they are simple questions not directed towards your privacy.

Confidentiality
Everything we will discuss here, including the answers to the questions, are confidential. Test results will be blinded and coded.

Voluntarism
Your participation is not mandatory and you can withdraw your consent at any time without suffering any pressure from us. Refusing to participate will not affect you in any way in your community and when you visit the hospital. In case of any questions or more information about the survey, please feel free to call the following numbers:
Crisantos Nsue Abeso Tel: 222 505 592 **Teresa Ayingono Mifumu** Tel: 222 079 697

CONSENT

I read and understood the information related to the survey. The objectives, procedures, potential risks and benefits were clearly explained to me. I understand that my participation is voluntary and I am free to stop at any time without suffering any form of pressure.

A. for children age less than 18 years

☐ I authorize my children to be tested and sampled
☐ I authorize my children to be tested **but not sampled**
☐ I do not authorize my children to be tested

Name of the person authorizing: ____ Tel: ______________________

Relation to the children: ___________________________ Signature / Thumbprint: __________________________

Name of surveyors: ___________________________________ Signature of surveyor: _____________________

Date: ____________________

B. For adults who are not able to sign

The information was explained to the people and they understood

Name of witness: ____ date: _________________

Signature of witness: _________________________

C. Other adults (+18 years) who are able to sign

1. Name of the person: ____ date: ____________________
☐ I agree to be tested and sampled
☐ I agree to be tested **but not sampled**

2. Name of the person: ____ date: ____________________
☐ I agree to be tested and sampled
☐ I agree to be tested **but not sampled**

3. Name of the person: ____ date: ____________________
☐ I agree to be tested and sampled
☐ I agree to be tested **but not sampled**

4. Name of the person: ____ date: ____________________
☐ I agree to be tested and sampled
☐ I agree to be tested **but not sampled**

5. Name of the person: ____ date: ____________________
☐ I agree to be tested and sampled
☐ I agree to be tested **but not sampled**

6. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

7. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

8. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

9. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

10. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

11. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

12. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

13. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

14. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

15. Name of the person: ____ date: ____________________

☐ I agree to be tested and sampled

☐ I agree to be tested **but not sampled**

APPENDIX B: SURVEY PERSONNEL

SURVEY ORGANIZERS
David Galick
Olivier Tresor Donfack Sontsa
Guillermo Garcia

GIS SUPPORT
Jeremias Nzamio Mba
Restituto Mba

DATA VISUALIZATION
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Marcos Mbulito Iyanga

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Faustino Etoho Ebang
Marcos Mbulito Iyanga

TREATMENT DISTRIBUTORS
Celestina Nzang Ndong Beyeng
Eugenia Boleche Bela
Josefina Nchama Esono

FIELD SUPERVISORS
Ana Delicia Caba Sepa
Benjamin Ndong Engonga Nchama
Federico Comsil Chochi
Juan Jose Edu Abeso
Oscar Nicolas Nguema Nzang
Samuel Vicente Evale Engonga

PRE-PACKAGING TEAM
Raul Memba Borico
Genoveva Mofuman Mba Nchama
María del Pilar Mangue Mitogo Nsee
Maribel Ada Nsue Mangue
Cefora Anastacia Eni Mba Oyana

DRIVERS
Mariano Ntutumu Ripacoho
Rufino Nsue Nsue
Jeremias Trillo Sabadel
Robustiano Mba Ngomo
Jose Mabale Nguema Asong
Elpidio Akogo Ntutumu
Narciso Ndong Evuna
Fernando Maye Ondo

SURVEYORS
Angel Serafin Ondo Andeme
Angel Nkili Mba Eyang
Agustin Gil Oraka Ondo
Angela Basi Kalo
Antonia Pasialo Dick
Benjamin Nguema Mba
Clara Nzang Obama Abegue
Diosdado May Akin
Francisco Ekang Mba Abegue
Jesus Angel Sepa Ekobo
Jesus Nguema Abeso Nsegue
Jose Félix Mbenga Obama

SURVEYORS (CONT.)
Jose Manuel May Mohaba
Jose Maria Nkogo Ebono Eyang
Juan Carlos Sima Mokuy
Juaquina Cachina Esapa
Justa Asini Abaga Mangue
Justo Juan Nsoho Abuy Andeme
Maria Luisa Ekifang Nsi Ongo
Mansueto Nguema Ndong Mikue
Marta Nchama Abeso Ayingono
Matutina Mangue Engonga Oyana
Mauricio Ernesta Mañana Nchama
Melodia Roca Compaña
Nicanor Nsue Angue Oyana
Pascual Owono Esono
Remigio Belope Bichi
Ricardo Klopa Somori
Romualdo Macías Evuna Nfono
Salvador Asumu Ndemesogo Ayeng
Santiago Mba Micha Baita
Santiago Ntonga Bikie
Santiago Tango Suaya
Teopista Justina Nsue Angue
Thelma Bokuma Rivas
Tecla Nzang Ntutumu Mikue

APPENDIX C: SURVEYORS EVALUATION CHECKLIST

PRESENTATION	
Presented correctly in the house?	YES / NO
Gave a clear explanation of the reason of visit	YES / NO
Informed the household on survey procedures	YES / NO
Informed the households on risks and benefits	YES / NO
Informed the household of the confidentality of the survey	YES / NO
Informed the household that participation is voluntary	YES / NO
MALARIA AND ANEMIA TESTING	
Correctly prepared lists of household members and visitors	YES / NO
Obtained signed informed consent before taking samples for testing	YES / NO
Organized working space appropriately	YES / NO
Labeled RDTs and filter papers with barcodes	ALWAYS / SOMETIMES / NEVER
Tested household members according to the order established in lists	YES / NO
Took temperature as per protocol	ALWAYS / SOMETIMES / NEVER
Cleaned finger before pricking	ALWAYS / SOMETIMES / NEVER
Waited for finger to dry before pricking	ALWAYS / SOMETIMES / NEVER
Cleaned the first drop of blood	ALWAYS / SOMETIMES / NEVER
Took a drop of blood for anemia testing as per protocol	ALWAYS / SOMETIMES / NEVER / NA
Wiped hemo-cuvette before inserting in hemocue	ALWAYS / SOMETIMES / NEVER / NA
Took drop of blood for malaria RDT as per protocol	ALWAYS / SOMETIMES / NEVER
Introduced blood in appropriate well on RDT	ALWAYS / SOMETIMES / NEVER
Introduced correct quantity of buffer in the appropriate well on RDT	ALWAYS / SOMETIMES / NEVER
Prepared good blood spots on filter paper	ALWAYS / SOMETIMES / NEVER / NA
Read malaria RDTs correctly and at proper time, as per protocol	ALWAYS / SOMETIMES / NEVER
Registered results on the lists of household members/visitors	ALWAYS / SOMETIMES / NEVER
Explained test results to the household	YES / NO
INTERVIEW	
Asked the questions without changing the meaning	ALWAYS / SOMETIMES / NEVER
Asked the questions without prompting answers	ALWAYS / SOMETIMES / NEVER
LONG SURVEY: Correctly prepared the costs book	ALWAYS / SOMETIMES / NEVER
LONG SURVEY: Correctly performed necessary cost calculations	ALWAYS / SOMETIMES / NEVER
Asked to observe bed nets	ALWAYS / SOMETIMES / NEVER / NA
Listed and identified the occupants of each bed net	ALWAYS / SOMETIMES / NEVER / NA
Correctly prepared referral/prescription for malaria-positive and anemic individuals	ALWAYS / SOMETIMES / NEVER / NA

APPENDIX D: CRUDE PREVALENCE AND CHILDHOOD MORTALITY ESTIMATES

Table D.1: Crude malaria prevalence in the general population

Number of valid rapid diagnostic tests (RDTs) and unweighted percentage of the surveyed population positive by RDT for any malaria parasite (malaria PR) and for *P. falciparum* (PfPR).

	Valid RDTs	Malaria PR (95% CI)	PfPR (95% CI)
Age			
<5	1,713	11.1 (9.6-12.8)	10.8 (9.3-12.5)
5-14	3,709	20.5 (18.9-22.1)	20.0 (18.5-21.6)
15-24	2,412	20.7 (19.1-22.4)	20.4 (18.8-22.1)
25-34	1,834	13.1 (11.7-14.7)	12.9 (11.5-14.4)
35-44	1,366	14.0 (12.3-15.8)	13.5 (11.9-15.4)
45-54	728	11.8 (9.7-14.3)	11.4 (9.3-13.9)
55+	821	8.0 (6.4-10.0)	7.7 (6.1-9.6)
Gender			
Female	6,666	14.7 (13.8-15.7)	14.3 (13.4-15.3)
Male	5,917	17.7 (16.7-18.8)	17.4 (16.4-18.5)
District			
Malabo	9,622	15.7 (14.8-16.6)	15.3 (14.4-16.3)
Baney	1,666	13.2 (11.2-15.5)	12.7 (10.8-15.0)
Luba	637	19.0 (15.8-22.7)	18.8 (15.6-22.6)
Riaba	658	28.1 (23.7-33.0)	27.2 (22.8-32.2)
Wealth quintile			
Lowest	2,064	20.9 (18.9-23.1)	20.4 (18.4-22.6)
Second	2,375	19.0 (17.0-21.1)	18.4 (16.5-20.5)
Middle	2,587	16.7 (14.8-18.7)	16.2 (14.4-18.2)
Fourth	2,681	15.6 (13.9-17.4)	15.3 (13.6-17.1)
Highest	2,876	10.5 (9.2-12.0)	10.3 (9.0-11.8)
Stratum			
Rural/high transmission	4,065	25.3 (23.7-27.0)	24.8 (23.1-26.5)
Urban/low transmission	8,518	11.8 (11.0-12.6)	11.5 (10.7-12.3)
Total	**12,583**	**16.2 (15.4-17.0)**	**15.8 (15.0-16.6)**

Table D.2: Crude malaria prevalence according to risk factors

Number of valid rapid diagnostic tests (RDTs) and unweighted percentage of the population positive by RDT for any malaria parasite (malaria PR) and for *P. falciparum* (PfPR) by risk factors for malaria

	Valid RDTs	Malaria PR (95% CI)	PfPR (95% CI)
2-week travel history			
No travel	12,207	15.9 (15.1-16.7)	15.5 (14.7-16.3)
Travel	352	25.0 (19.9-30.9)	25.0 (19.9-30.9)
8-week travel history			
No travel	11,758	15.5 (14.7-16.3)	15.1 (14.3-15.9)
Travel	801	26.5 (23.0-30.2)	26.5 (23.0-30.2)
Most time spent during day			
Inside neighborhood	10,993	16.8 (15.9-17.6)	16.4 (15.5-17.3)
Outside neighborhood	1,539	11.6 (10.1-13.3)	11.4 (9.9-13.0)
Most time spent at night			
Inside neighborhood	12,354	16.2 (15.4-17.0)	15.8 (15.1-16.6)
Outside neighborhood	203	11.8 (8.0-17.2)	11.3 (7.6-16.7)
When came indoors			
Before 6PM	1,416	16.7 (14.5-19.1)	16.4 (14.2-18.8)
6PM-8PM	3,379	17.2 (15.7-18.9)	16.8 (15.3-18.4)
8PM-10PM	3,787	15.9 (14.6-17.3)	15.5 (14.2-16.9)
After 10PM	2,093	16.2 (14.5-18.1)	15.9 (14.2-17.8)
When went to bed			
Before 8PM	527	18.6 (15.2-22.5)	18.4 (15.1-22.3)
8PM-10PM	4,328	18.0 (16.7-19.4)	17.6 (16.3-18.9)
10PM-12AM	5,063	15.0 (14.0-16.1)	14.6 (13.6-15.7)
After 12AM	1,602	13.2 (11.4-15.3)	13.1 (11.3-15.2)
Total	**12,583**	**16.2 (15.4-17.0)**	**15.8 (15.0-16.6)**

Table D.3: Crude malaria and anemia prevalence in children under 5

Number of valid rapid diagnostic tests (RDTs) performed on children under 5, unweighted percentage positive by RDT for any malaria parasite (malaria PR) and for *P. falciparum* (PfPR), and number of valid hemoglobin results and unweighted percentage of this group with moderate anemia (<8g/dl).

	Malaria testing			Anemia testing	
	Valid RDTs	Malaria PR (95% CI)	PfPR (95% CI)	Valid anemia tests	Anemic (95% CI)
Age in months					
<12	161	5.0 (2.5-9.5)	5.0 (2.5-9.5)	160	2.5 (1.0-6.4)
12-23	385	7.8 (5.6-10.8)	7.8 (5.6-10.8)	384	3.6 (2.2-6.0)
24-35	380	11.3 (8.5-14.9)	10.5 (7.8-14.0)	376	1.1 (0.4-2.7)
36-47	353	13.0 (9.9-16.9)	12.7 (9.7-16.6)	350	2.0 (1.0-4.1)
48-59	434	14.5 (11.6-18.1)	14.3 (11.3-17.8)	430	1.4 (0.6-3.0)
District					
Malabo	1,349	10.4 (8.7-12.3)	10.2 (8.5-12.0)	1,336	2.2 (1.5-3.1)
Baney	226	11.1 (7.2-16.7)	10.6 (6.8-16.2)	226	1.8 (0.7-4.6)
Luba	55	16.4 (7.6-31.8)	16.4 (7.6-31.8)	55	1.8 (0.2-12.9)
Riaba	83	19.3 (10.7-32.1)	18.1 (9.8-31.0)	83	1.2 (0.1-10.9)
Wealth quintile					
Lowest	232	17.2 (12.6-23.2)	17.2 (12.6-23.2)	230	3.0 (1.5-6.1)
Second	350	12.9 (9.7-16.9)	12.3 (9.1-16.3)	348	3.7 (2.2-6.2)
Middle	384	11.5 (8.2-15.7)	10.7 (7.5-14.9)	380	1.6 (0.7-3.4)
Fourth	363	11.3 (8.1-15.5)	11.3 (8.1-15.5)	361	2.2 (1.1-4.3)
Highest	384	5.2 (3.4-8.0)	5.2 (3.4-8.0)	381	0.3 (0.0-1.8)
Stratum					
Rural/high transmission	563	20.6 (17.1-24.6)	20.2 (16.8-24.2)	558	2.5 (1.5-4.1)
Urban/low transmission	1,150	6.4 (5.1-8.1)	6.2 (4.9-7.8)	1,142	1.8 (1.2-2.8)
Total	**1,713**	**11.1 (9.6-12.8)**	**10.8 (9.3-12.5)**	**1,700**	**2.1 (1.5-2.8)**

Table D.4: Crude malaria and anemia prevalence in pregnant women

Number of pregnant women with a valid rapid diagnostic test (RDT) result, unweighted percentage positive by RDT for any malaria parasite (malaria PR) and for *P. falciparum* (PfPR); number of pregnant women with valid hemoglobin results and unweighted percentage with moderate anemia (hemoglobin <8 g/dl).

	Malaria testing			Anemia testing	
	Valid RDTs	Malaria PR (95% CI)	PfPR (95% CI)	Valid anemia tests	Anemic (95% CI)
Age					
<5	0			0	
5-14	0			0	
15-24	89	16.9 (10.5-25.9)	16.9 (10.5-25.9)	89	7.9 (3.8-15.5)
25-34	104	9.6 (5.3-16.9)	9.6 (5.3-16.9)	103	2.9 (1.0-8.6)
35-44	31	12.9 (4.8-30.3)	12.9 (4.8-30.3)	31	0.0
45-54	1	100.0	100.0	1	0.0
55+	0			0	
District					
Malabo	169	13.6 (9.2-19.8)	13.6 (9.2-19.8)	168	3.6 (1.6-7.7)
Baney	35	8.6 (2.6-24.6)	8.6 (2.6-24.6)	35	8.6 (2.6-24.7)
Luba	10	0.0	0.0	10	10.0 (0.8-60.2)
Riaba	11	36.4 (10.8-72.9)	36.4 (10.8-72.9)	11	0.0
Education level					
At most primary	17	35.3 (13.9-64.8)	35.3 (13.9-64.8)	17	11.8 (2.6-40.4)
Secondary	81	13.6 (7.7-22.8)	13.6 (7.7-22.8)	80	5.0 (1.9-12.5)
Post-secondary	69	4.3 (1.4-12.6)	4.3 (1.4-12.6)	69	2.9 (0.7-10.8)
Unknown	51	17.6 (9.7-30.0)	17.6 (9.7-30.0)	51	3.9 (1.0-14.5)
Wealth quintile					
Lowest	32	18.8 (8.8-35.6)	18.8 (8.8-35.6)	31	6.5 (1.6-22.8)
Second	46	13.0 (5.9-26.2)	13.0 (5.9-26.2)	46	4.3 (1.1-16.0)
Middle	57	10.5 (4.3-23.5)	10.5 (4.3-23.5)	57	7.0 (2.7-17.3)
Fourth	49	16.3 (8.4-29.2)	16.3 (8.4-29.2)	49	4.1 (1.0-15.1)
Highest	41	9.8 (3.7-23.5)	9.8 (3.7-23.5)	41	0.0
Stratum					
Rural/high transmission	65	21.5 (12.8-33.8)	21.5 (12.8-33.8)	65	6.2 (2.3-15.3)
Urban/low transmission	160	10.0 (6.3-15.6)	10.0 (6.3-15.6)	159	3.8 (1.7-8.1)
Total	**225**	**13.3 (9.5-18.4)**	**13.3 (9.5-18.4)**	**224**	**4.5 (2.4-8.0)**

Table D.5: Crude neonatal, infant and childhood (under 5) mortality

Unweighted rate of deaths per 1,000 live births in the first month (neonatal), first year (infant) and first five years (under 5) of life by age of mother at birth, gender of child, birth order, district of residence and stratum

	Neonatal mortality	Infant mortality	Under 5 mortality	Births registered
Mother's age at birth				
< 20	18.1 (0.5-28.0)	32.6 (7.1-45.0)	48.2 (17.1-78.2)	277
20-29	12.5 (8.3-21.7)	27.9 (17.2-36.4)	38.1 (25.4-50.7)	1,194
30-39	11.4 (4.0-24.3)	27.3 (12.1-38.2)	30.2 (15.5-44.8)	702
40-49	27.6 (0.0-64.0)	27.6 (0.0-64.0)	27.6 (0.0-64.0)	72
Gender				
Female	10.1 (4.9-17.1)	19.2 (9.7-26.3)	28.7 (16.2-41.0)	1,085
Male	15.5 (10.9-26.9)	35.2 (23.3-44.8)	44.8 (31.2-58.1)	1,160
Birth order				
1	16.8 (8.2-25.3)	25.8 (13.9-34.6)	36.1 (22.1-49.9)	832
2	11.7 (5.1-20.8)	30.2 (16.7-40.4)	40.0 (24.4-55.2)	767
3+	10.8 (5.2-25.6)	28.8 (12.2-40.1)	33.4 (16.2-50.4)	646
Wealth quintile				
Lowest	18.1 (1.8-34.2)	28.1 (4.0-38.3)	28.1 (6.5-49.2)	330
Second	14.8 (5.6-28.0)	33.1 (14.0-46.7)	49.2 (25.3-72.6)	473
Middle	13.4 (2.4-20.3)	28.7 (11.2-41.1)	31.4 (14.8-47.7)	525
Fourth	10.8 (4.1-30.1)	34.5 (13.4-49.0)	49.2 (23.0-74.7)	463
Highest	15.4 (2.9-23.3)	25.3 (7.4-33.4)	25.3 (7.1-43.2)	454
District				
Malabo	13.6 (9.5-21.1)	29.2 (20.2-36.6)	37.7 (27.0-48.2)	1,757
Baney	7.1 (0.0-22.1)	18.1 (0.0-35.9)	18.1 (0.0-35.9)	282
Luba	21.4 (0.0-61.2)	49.0 (0.0-61.2)	49.0 (0.0-111.4)	93
Riaba	28.4 (0.0-41.1)	28.4 (0.0-41.1)	66.9 (0.0-129.5)	113
Stratum				
Rural/high transmission	20.9 (11.5-35.7)	33.3 (17.2-45.6)	50.6 (28.8-72.0)	715
Urban/low transmission	9.1 (6.0-16.2)	24.7 (15.8-31.9)	30.6 (20.9-40.2)	1,530
Total	**12.4 (9.9-20.3)**	**26.9 (19.2-33.4)**	**37.0 (27.4-46.4)**	**2,245**